Environmental capacity constraints in macroeconomic policy analysis

Dodo J. Thampapillai

Lee Kuan Yew School of Public Policy,
National University of Singapore,
Singapore
E-mail: spptj@nus.edu.sg

Abstract: This paper deals with the conceptualisation of environmental capital (KN) as an explicit argument in frameworks that exposit economic growth and performance. The omission of KN represents a major flaw in macroeconomic policy analysis because the recognition of KN affects the determination of productive capacity. Empirical illustrations are offered with reference to Australia, Korea and the USA. In the case of the Australian economy, policy decisions are possibly being evaluated on income domains that exceed the productive capacity dictated by KN.

Keywords: Environmental capital; environmental capital depreciation; internalisation; macroeconomics; capacity constraints.

Reference to this paper should be made as follows: Thampapillai, D.J. (2008) 'Environmental capacity constraints in macroeconomic policy analysis', *Int. J. Environment, Workplace and Employment*, Vol. 4, No. 1, pp.1–14.

Biographical notes: Dodo Thampapillai is an economist at the Lee Kuan Yew School of Public Policy, National University of Singapore. He also holds a Personal Chair in environmental economics at Macquarie University and an Adjunct Professorship in the same field at the Swedish University of Agricultural Sciences at Uppsala. His current research focus is on macroeconomics and the environment and the revised edition of his text *Environmental Economics: Concepts Methods and Policies* (Oxford University Press 2002, 2006).

An earlier version of this paper was presented as a key note address to the *International Conference on 'Business, Environment, International Competitiveness and Sustainable Development of the Asia Pacific Economies' – 03 December 2007 Monash University Kuala Lumpur Malaysia*.

1 Introduction

Nature is capital. An economy cannot grow (let alone exist) without nature. These are now widely accepted premises in both rich and poor countries. Nevertheless, to date, the economists' approach to defining and modelling economic growth has not offered full cognizance to these premises. If nature is essential for the existence and performance of an economy, then nature must be included as a central argument in the definition and exposition of economic growth. Neoclassical economics of the 1950–1970 vintage had confined the exposition of economic growth to two factors: manufactured capital (KM) and labour (L). That is, the production function for explaining national income (Y) was:

{Y = f(KM, L)}; (Solow, 1956). Savings and investment were seen as key instruments prompting the expansion in stocks of KM. The then literature was also preoccupied with the substitutability between KM and L in achieving specified targets of economic growth (Todaro and Smith, 2002). In the aftermath of the OPEC oil crisis, exhaustible resources found their way into the production function and the substitutability of more durable forms of KM for the exhaustible resources became a point of interest; (Hartwick, 1978; Dasgupta and Heal, 1979; Solow, 1986). More recent explanations of economic growth retain the same production function {Y = f(KM, L)}. However, they are focussed on achieving economic growth through increases in factor productivity and/or the factor utilisation rates; (Todaro and Smith, 2002). The importance of nature though acknowledged (amongst several other important factors), remains ancillary. Nature is perceived to enhance both factor productivity and factor utilisation and thereby enhance economic growth.

The main argument in this paper is that the exposition of economic growth must include nature as a central argument. For this purpose, the production function {Y = f(KM, L)}, must be replaced with {Y = g(KM, L, KN)}, where KN represents environmental capital. The next two sections deal with the conceptualisation of KN and its relationship with national income (Y). This relationship is explained in terms of the depreciation cost of KN and is then made use of in Section 4 to illustrate how some basic frameworks in macroeconomics would get modified. Such modification has significant implications for the capacity of economic growth. Some empirical illustrations are then offered with reference to Australia, South Korea and the USA.

2 Environmental capital

Alfred Marshall's (1891) text (which is perhaps the first concise book on modern neoclassical economics) describes only *nature* and *man* as the principal agents of production. The Marshallian influence is observed in Fisher (1904) who draws on environmental assets such as lakes and rivers as analogies to explain the concepts of stocks and flows. That is, in his attempt to lay out a conceptual framework for capital, Fisher took it for granted that nature is capital.

Like any other form of capital, nature is durable, it generates a flow of services over time and it depreciates (degrades) with usage. The usage of KN is its engagement in economic growth and represents the extraction of services. As environmental scientists would argue these services are embodied in two types of functions:

- source function that involves the provision of raw materials and amenities and
- sink function whereby KN serves as a receptacle for various wastes and emissions.

Hence, it is possible to conceptualise KN as the foundational capital on which the economy rests. The depreciation of KN is the diminution of the source and sink functions that renders the foundation fragile. As illustrated elsewhere (Thampapillai, 2002), efforts to enhance the source and sink functions can be regarded as investments in KN; and efforts that attempt to maintain these functions can be regarded as depreciation. The distinction between an investment in KN and the depreciation KN can be elusive. For example, for nearly two to three decades, the Aral Sea has been a dead resource. The efforts that are currently underway to bring this sea back to life can be regarded as an investment. In contrast, the activities such as water quality, management of rivers, soil conservation on farms and air pollution abatement can be regarded as efforts to arrest the depreciation of environmental endowments.

The logical extension of such conceptualisation is to redefine national product. If during a given time period *t*, gross domestic product, environmental investments and environmental depreciation are respectively denoted by: GDP(t), $I_{KN}(t)$ and $C_{EM}(t)$, then the revised definition of national product will be [GDP(t) + $I_{KN}(t)$ − $C_{EM}(t)$]. If we suppose that current estimates of GDP(t) include $I_{KN}(t)$, then the revised definition of national product is simply [GDP(t) − $C_{EM}(t)$]. In fact, most expenditures pertaining to $I_{KN}(t)$ are included in the estimates of GDP and so are some environmental depreciation costs as explained below.

The basic definition of GDP is the summation of consumption (C), investment (I), government expenditure (G) and net exports (NX). That is: (C+I+G+NX). An examination of the national income accounts of most countries is likely to reveal that some costs of environmental depreciation appear as positive items in GDP; that is, they are mostly included in either C or I or G. For example, costs of waste management are normally found in G, and expenditures by firms and households in terms of water filters and air filters to offset the deterioration of amenities are included in C. At the same time, other items such as the loss of topsoil and biodiversity are ignored. Hence, in the estimation of $C_{EM}(t)$ one needs to separate out items that are currently included in GDP as well as determine values for items that have been ignored.

3 A conceptual framework for the depreciation of KN

This can be explained via the relationship between the $C_{EM}(t)$ and national income $Y(t)$. It is reasonable to assume that increases in $Y(t)$ would prompt increases in $C_{EM}(t)$, and that increases in $Y(t)$ are feasible only up to some threshold. Any attempt to increase $Y(t)$ beyond this threshold could exhaust the source and sink capacities of KN and thus push $C_{EM}(t)$ towards infinity.

Initially assume that the relationship between $C_{EM}(t)$ and $Y(t)$, namely $C_{EM}(t) = g[Y(t)]$ can be as described in Figure 1 as follows:

$$C_{EM}(t) = C_{ER}(t) + \omega Y(t) \text{ for } [0<Y(t)<Y_h(t); \text{ and } \omega>0], \quad (1)$$

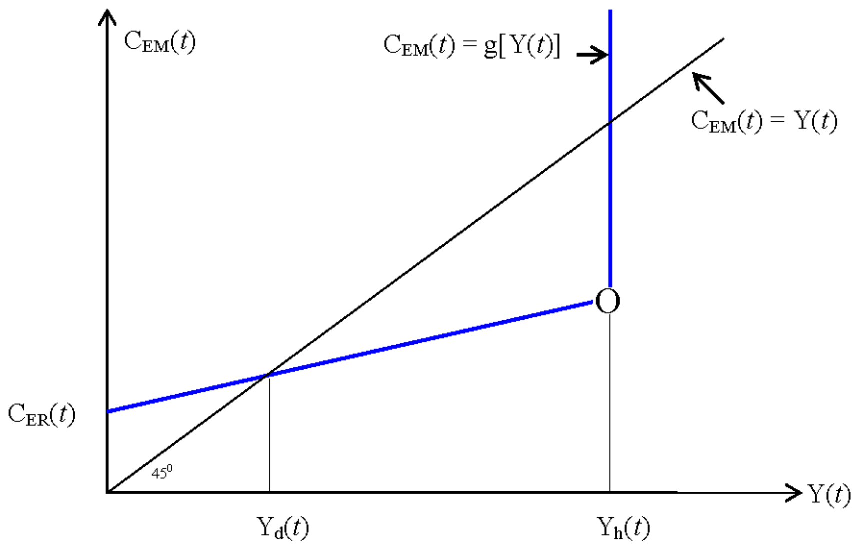
$$C_{EM}(t) \to \infty \quad \text{for } [Y(t)>Y_h(t)]. \quad (2)$$

That is, during any accounting period *t*, $Y_h(t)$ is the maximum limit to which output can be produced. This is a limit in terms of the capacity of the KN to provide sink and source services. Any attempt to increase income beyond $Y_h(t)$ results in irreversible environmental damage, and hence $C_{EM}(t)$ tends to infinity. Further, within the limit of $Y_h(t)$ following equation (1) above, the size of $C_{EM}(t)$ is governed by: the extent of environmental maintenance that has to be done regardless the size of income, namely $C_{ER}(t)$; and ω, the rate at which $C_{EM}(t)$ increases for unit increases in Y. ω can also be regarded as the marginal rate of environmental degradation. That is:

$$\omega = \frac{\Delta C_{EM}(t)}{\Delta Y(t)}. \quad (3)$$

Suppose that Figure 1 represents the state of the environment for a specific accounting period. The feasible set of output targets for this period are hence defined by the domain $\{Y_d(t) < Y(t) < Y_h(t)\}$. This is because over this domain the depreciation allowance for nature is below the 45° line; that is $C_{EM}(t)$ is $< Y(t)$. The upper limit of this domain, namely $Y_h(t)$, denotes the target income that maximises $Y(t)$ in excess of $C_{EM}(t)$. However, from equation (2), $Y_h(t)$ is also the income level that brings the economy to the brink of an environmental disaster. This difficulty is caused due to the linear and discontinuous assumptions that have been made for $C_{EM}(t) = g[Y(t)]$ in equations (1) and (2).

Figure 1 Environmental depreciation function – linear and discontinuous (see online version for colours)



Hence, a non-linear relationship, such as an exponential function, is perhaps more appropriate. Yet, the linear function can prove useful, especially for joint consideration in linear macroeconomic models and when we are able to assume that $Y_h(t)$ is sufficiently large to be ignored (see, for example Mallick, Sinden and Thampapillai, 2000)

Consider now an exponential cost function of the following form:

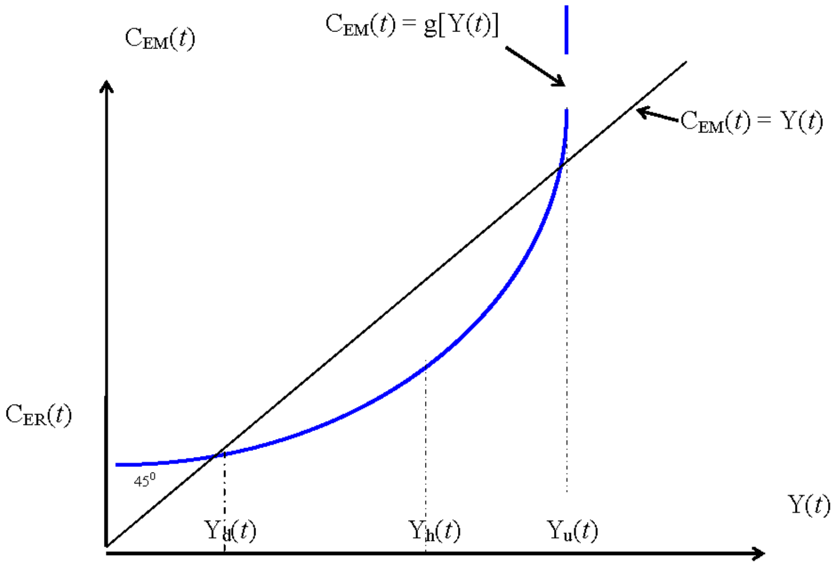
$$C_{EM}(t) = C_{ER}(t)e^{\eta Y(t)}. \tag{4}$$

In equation (4), η represents a compounding rate for the environmental costs. $C_{ER}(t)$ represents the specific value of $C_{EM}(t)$ when $(Y(t) \to 0)$. That is, as indicated before, it is the amount of environmental maintenance that has to be performed regardless the size of national income. From equation (4), it is possible to define η as:

$$\eta = \frac{[\text{In}C_{EM}(t) - \text{In}C_{ER}(t)]}{Y(t)}. \tag{5}$$

From Figure 2 which represents this exponential function, it can be seen that the feasible set of output targets are given by the domain $\{Y_d(t) < Y(t) < Y_u(t)\}$. Further, note that in Figure 2, output is feasible only when the depreciation function can intersect the 45° line, and this can in turn occur only when the gradient of the function at its first point of intersection is <1. Alternatively, when the gradient is >1, the environmental depreciation function is above the 45° line indicating that the state of the environment is being heavily degraded. It is now possible to illustrate how KN can become a determinant of an important concept in macroeconomics, namely productive capacity. As is evident from Figure 2, an economy loses its productive capacity if $C_{EM}(t)$ lies above the 45° line; that is, the gradient of $C_{EM}(t)$ exceeds 1.

Figure 2 Environmental depreciation function – exponential (see online version for colours)



The gradient of $C_{EM}(t)$ is also the marginal rate of environmental degradation and can be defined as:

$$\frac{dC_{EM}(t)}{dY(t)} = C_{ER}(t)\eta e^{\eta Y(t)}. \tag{6}$$

The maximising value of national income, namely $Y_h(t)$ in Figure 2, can be derived by equating (6) to 1. That is:

$$Y_h(t) = \frac{-[\text{In}C_{ER}(t) - \text{In}\eta]}{\eta}. \tag{7}$$

The relationship $C_{EM}(t) = g[Y(t)]$ was tested using time series data (1970–2000) on the costs of air pollution abatement and national income for Australia, South Korea and the USA. The data used for this analysis are presented in Table A1 in the appendix. The main features of the estimates derived from the analysis are summarised in Table 1.

Of the three economies considered here, Australia is the worst performer in terms of the gradient and hence productive capacity. The C_{ER} values; however, are not directly comparable because they are measured in different local currency units (LCU). But these are reflective of the level of economic activity. It is important to note that here the concept of KN has been confined to that of an airshed. If the totality of KN were to be considered, then one is likely to observe much higher values for C_{ER} and the gradient.

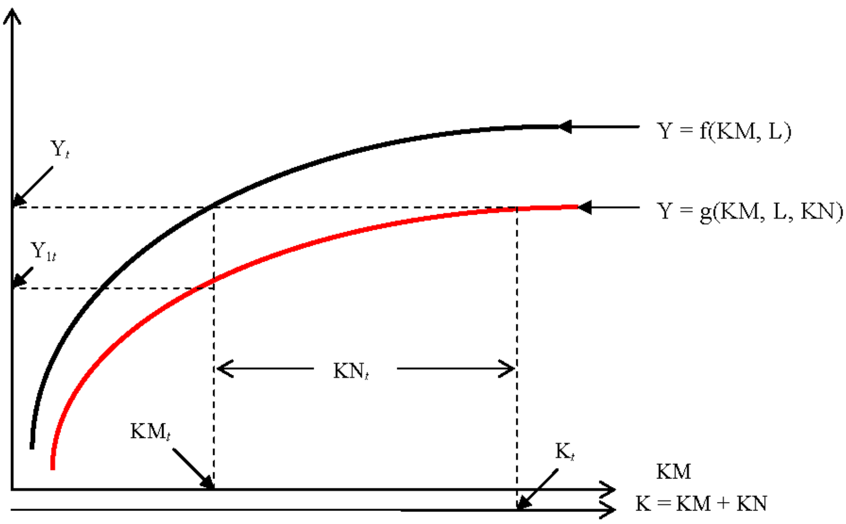
Table 1 Depreciation cost of KN $\{C_{EM}(t) = C_{ER}(t)e^{\eta Y(t)}\}$

	Australia	*Korea*	*USA*
C_{ER} (Million LCU)	11,281	4000	356,001
η	(3×10^{-6})	(6×10^{-9})	(8×10^{-8})
$\left\{\frac{dC_{EM}}{dY}\right\}$ (For Year 2000)	0.171	(3.06×10^{-5})	0.056

4 Internalising KN macroeconomic frameworks

Consider now the internalisation of KN into two basic frameworks in macroeconomics, namely the production function and an elementary aggregate demand (AD) – aggregate supply (AS) framework. As indicated above, the production function in models of economic growth is confined to the form {Y = f(KM, L)}. Such a function, when estimated, would display the contribution of specific quantities of KM and L towards the formation of given values of Y. For example from Figure 3, it would appear on the basis of {Y = f(KM, L)} that a stock size of KM_t is responsible for the formation of Y_t. To illustrate the effect of {Y = g(KM, L, KN)}, assume that the size of KN can be measured in the same units of measure as that of KM. Further assume that KM and KN can be aggregated on a one-to-one basis into a common aggregate capital measure, namely K. That is, (K = KM + KN).

Figure 3 Ignoring KN overstates the role of KM (see online version for colours)

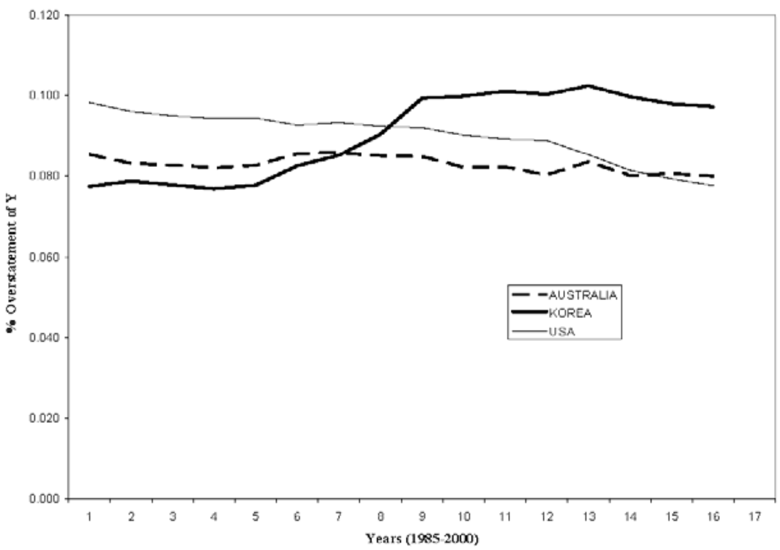


When the utilisation of KN is also included, one finds that much more of K is needed to explain the formation of Y_t. From the illustration provided in Figure 3, it is observed that the performance of the economy is overstated by an amount equalling ($Y_t - Y_{1t}$). Trends in the overstatement of Y for the period 1985–2000 are presented in Table 2 and Figure 4 for Australia, Korea and the USA.

Table 2 Trends in the percentage overstatement of Y

	Australia	*Korea*	*USA*
1985	0.085	0.077	0.098
1986	0.083	0.079	0.096
1987	0.083	0.078	0.095
1988	0.082	0.077	0.094
1989	0.083	0.078	0.094
1990	0.086	0.083	0.093
1991	0.086	0.085	0.093
1992	0.085	0.091	0.092
1993	0.085	0.099	0.092
1994	0.082	0.100	0.090
1995	0.082	0.101	0.089
1996	0.080	0.100	0.089
1997	0.084	0.103	0.085
1998	0.080	0.100	0.081
1999	0.081	0.098	0.079
2000	0.080	0.097	0.078

Figure 4 Trends in the percentage overstatement of Y



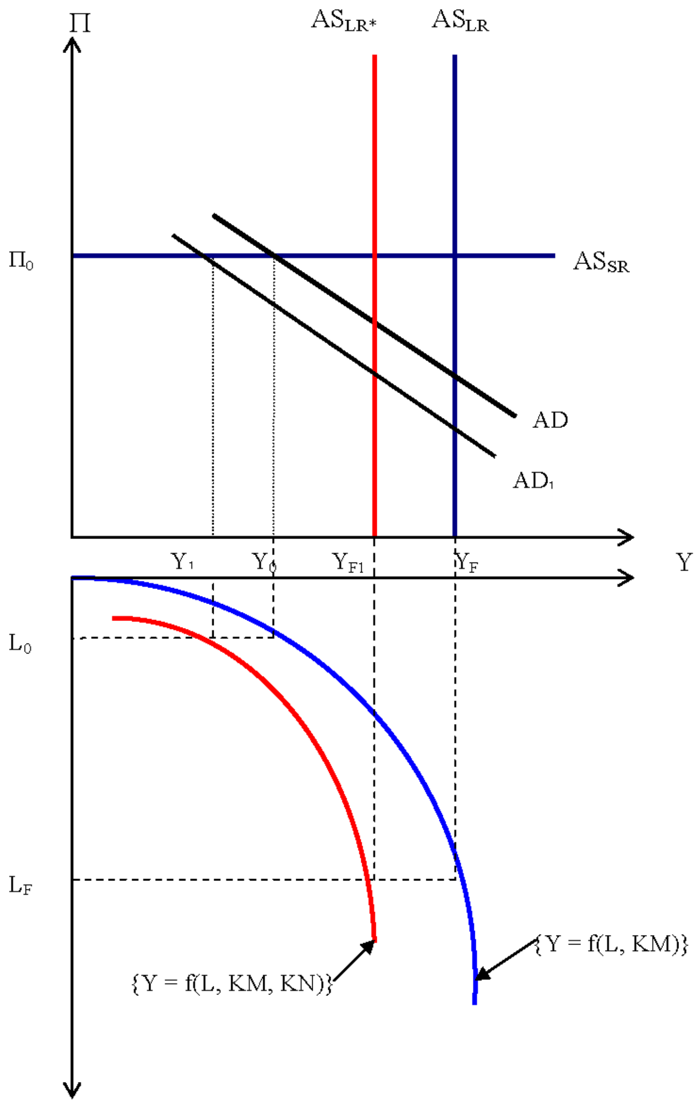
The values presented in Table 2 and Figure 4 depend on the estimation of KN. A detailed methodology for this estimation is presented elsewhere; (Thampapillai, 2007) and a synopsis is given in the appendix. It is noteworthy that the extent of overestimation of Y for South Korea has been on the rise for the period 1988–1996 from 7.7% to nearly 10%. This was also the period of the so-called Asian Miracle with South Korea being described as one of the Asian Tigers. It is possible to argue that in the absence of the overestimation of Y, the Asian Tigers might have been somewhat tamer and the overinvestment that eventually led to the Asian Financial Crisis might have been diluted. It is also evident that the extent of overestimation is marginally decreasing in both Australia and the USA implying perhaps the effect of compliance with stringent environmental standards.

The elementary AD–AS framework explains the relationship between the rate of inflation and the size of real national product. This is illustrated in the upper panel of Figure 5. When national product is measured as the sum of real final expenditures (that is AD), an inverse relationship is depicted as illustrated in Figure 5. When national product is measured as the sum of real final incomes (that is, AS), it is convenient to assume that in the short-run, AS is a horizontal straight line at the prevailing rate of inflation (Π_0) – AS_{SR} in Figure 5. This is because in the short-run, producers are unable to adjust to changes in inflation. The long-run perspective of AS is that an economy cannot exceed its productive capacity. Hence, the long-term view of AS is a vertical line at productive capacity (full employment). This is illustrated by AS_{LR} at Y_F in Figure 5. If the observed level of income (Y_0) is assumed to be in equilibrium with AS_{SR}, then the economy displays a recessionary output gap (Y_F – Y_0) that has to be closed. The lower panel of Figure 5 displays the production functions that provide information on employment/ unemployment issues that could be resolved within the AD–AS framework.

Consider first the function of the form {Y = f(L, KM)} – with L as the explanatory variable and KM fixed at some specific level. Suppose that the employment levels that correspond with (Y_0, Y_F) are (L_0, L_F). Then, the closure of the output gap will also result in the elimination of unemployment (L_F – L_0). That is, the policy makers will choose appropriate policies on the understanding that the state of the economy is described by AD, AS_{SR} and AS_{LR} with pertinent income and employment levels to deal with being (Y_0, Y_F) are (L_0, L_F).

Consider now the implication of internalising KN into this framework. Although the observed level of Y is Y_0, the true performance level has to be (Y_0 – C_{EM}) denoted in Figure 5 as Y_1. The true productive capacity of the economy is also not Y_F, but rather (Y_F – C_{EM}), denoted in Figure 5 as Y_{F1}. That is the true long-term perspective of AS is then AS_{LR*} and not AS_{LR}. This means that the true performance level of the economy, that is (AD_1, AS_{SR} and AS_{LR*}), is to the left of perceived level of performance. In order to attain the correct policy domain ($Y_1 \leftrightarrow Y_{F1}$), it is necessary to revise the production function to the form {Y = g(KM, L, KN)}. That is shift the production function downwards as illustrated in Figure 5.

Figure 5 AD–AS framework and the production functions (see online version for colours)



For illustrative purposes, consider the case of the Australian economy in 2005. On the basis of information presented in the World Development Indicators (World Bank, 2006), the state of the economy as perceived by policy makers was:

Π_0 = 1.0466 (4.66%; Inflation rate scale indexed such that $\Pi = 1$ implies zero inflation)

Y_0 = $807 billion (constant 2000 LCU)

Y_F = $852 billion (constant 2000 LCU)

L_0 = 9.805 million persons

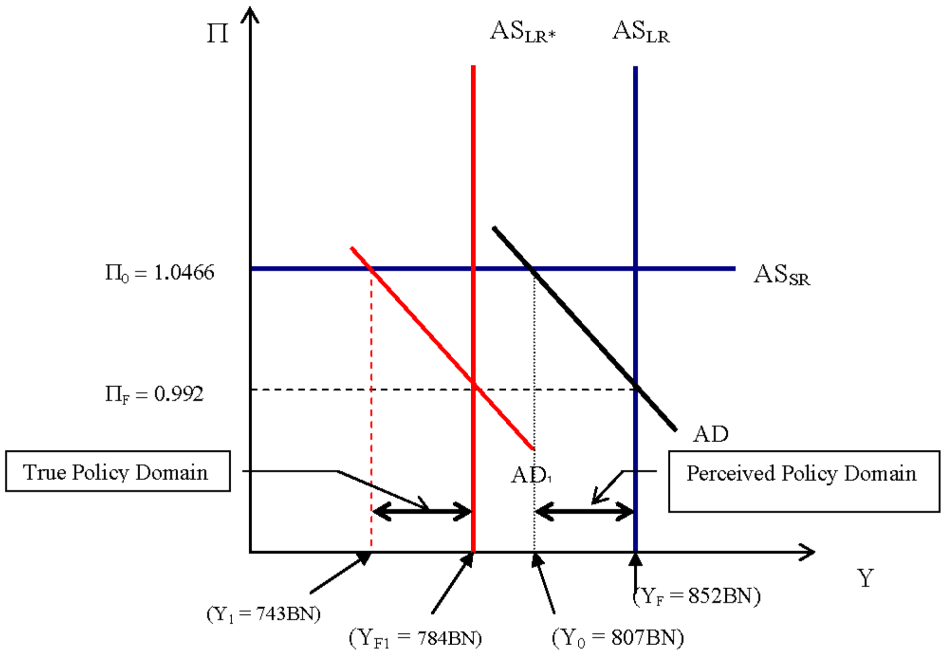
L_F = 10.343 million persons

The AD–AS sketch in Figure 6 encapsulates this information. The coordinates for the AD function were obtained by adapting the standard quantity equation as follows:

$$\Pi_t = \frac{M_t * V_t}{P_{t-1} * Y_t}, \tag{8}$$

where for a given year t, M_t is money stock; V_t is the velocity and P_{t-1} is the price level of the previous year.

Figure 6 Sketch of perceived vs. true state of the Australian economy (2005). (Here it was assumed that the prevailing rate of inflation will remain unaffected when the domain adjustment is made from (807BN ↔ 852BN) to (743BN ↔ 784BN) on the premise that there would be downward adjustment in the velocity of money circulation. Further, the level of Π_F was estimated by substituting the appropriate value for productive capacity into equation (8)) (see online version for colours)



Now observe that the policy domain changes significantly when KN is internalised. Following the analysis presented earlier, Y is overstated by at least 8% in Australia. This means that the true levels of performance (Y_1) and productive capacity (Y_{F1}) are:

Y_1 = $743 billion (constant 2000 LCU)

Y_{F1} = $784 billion (constant 2000 LCU)

Note that the true productive capacity is less than the perceived level of performance. That is, policy makers should have focused on the domain (743BN ↔ 784BN) instead of (807BN ↔ 852BN). The change of focus on the domain has implications at a wide range of levels including the choice of policy instruments for intervention.

6 Concluding remarks

It was possible to illustrate in this paper that even in countries, such as Australia, which display reasonable compliance with environmental standards, the policy domain is significantly misplaced. Such misplacement is likely to be significantly worse in developing countries.

It is necessary to explore the reasons for the misplacement of the domain in a country such as Australia. One of the reasons can be measurement error with reference to C_{EM}. As indicated, the values were taken from Thampapillai (2007) where the pollutant loads were estimated from total energy consumption and per costs of abatement were estimated following Hartman et al. (1997). Even if the technical improvements in energy consumption and pollution abatement would have occurred during the past decade, one must acknowledge the following. All three economies considered here continue to rely on fossil fuel (especially coal) for energy supply. Emission abatement in coal power generators have not gone far beyond filtration methods and have not as yet encompassed closed-loop systems. Hence, the measurement error is likely to be marginal. Besides, one must also note that the estimates of C_{EM} are confined to the context of an airshed. These estimates are likely to be much larger if the totality of KN was considered; that is soil, water, forests, biodiversity etc.

A more plausible reason for the misplacement of the income domain could be a growing trend of income inequalities and the escalation of wages amongst the high-income earners. In a comprehensive review of top incomes in Australia, Atkinson and Leigh (2006) demonstrate the following observations (amongst many others):

- in 2002, the richest 10% held 31.34% of national income
- wages of CEOs on average exceeded 3.5 million Australian dollars/year
- the richest 200 persons held 1.75% of income in 2001.

Such data illustrates that the Australian economy is becoming dualistic. It is possible to argue that the rightward shift of the AD schedules is driven by the high-income earners. In such a context, attempts to maintain environmental standards at the microeconomic level get negated by the surge in spending (AD) caused by excessively high wages. Further, since AS by definition represents the sum of all real incomes, it is possible to argue that the productive capacity of the economy is overstated. Hence, correcting these wages towards true social opportunity costs would have the effect of shifting the perceived domain towards the true domain in Figure 6.

When KN is excluded from policy analysis, then claims to economic growth and high performance are very much mistaken. These mistaken claims can only exacerbate environmental damage and hence render several economies fragile over the long-run.

References

Atkinson, A.B. and Leigh, A. (March 2006) *The Distribution of Top Incomes in Australia*, Discussion Paper No. 514, Centre for Economic Policy Research, Australian National University.

Dasgupta, P. and Heal, G.M. (1979) *Economic Theory of Exhaustible Resources,* Cambridge University Press, Cambridge.

Fisher, I. (1904) 'Precedents for defining capital', *Quarterly Journal of Economics,* Vol. 18, No. 3, pp.386–408.

Hartman, R.S., Wheeler, D. and Singh, M. (June 1997) 'The cost of air pollution abatement', *Applied Economics*, Vol. 29, No.6, pp.759–774.

Hartwick, J. (1978) 'Investing returns from depleting renewable resource stocks and intergenerational equity', *Economic Letters*, Vol. 1, No. 1: pp.85–88.

Mallick, S., Sinden, J.A. and Thampapillai, D.J. (June 2000) 'The relationship between environmentally sustainable income, employment and wages in Australia', *Australian Economic Papers,* Vol. 39, No. 2, pp.231–44.

Marshall, A. (1891) *Principles of Economics,*. Macmillan,. London.

Solow, R. (1956) 'A contribution to the theory of economic growth', *Quarterly Journal of Economics*, Vol. 70, No. 1,:pp.65–94.

Solow, R.M. (1986) 'On the Intergenerational Allocation of Natural Resources', *Scandinavian Journal of Economics,* Vol. 88, No. 1: pp.141–149.

Thampapillai, D.J. and Uhlin, H-E. (1997) 'Environmental capital and sustainable income: basic concepts and empirical tests', *Cambridge Journal of Economics*, Vol. 21, No. 3, 379 –394.

Thampapillai, D.J. (August 2007) 'The scarcity of environmental capital and economic growth: a comparative study of Australia and the United States', *Singapore Economic Review*.

Thampapillai, D.J.(2002) *Environmental Economics: Concepts Methods and Policies*, Oxford University Press, Melbourne.

Appendix: the estimation of KN

The main assumption is that an extended Cobb–Douglas production function of the following form is a valid descriptor of the distribution of Y between, KM, L and KN:

$$Y=\alpha KM^{\theta} L^{\lambda} KN^{\delta} \tag{A1}$$

Such that $\theta+\lambda+\delta=1$.

The validity of equation (A1) permits the elicitation of values for θ, λ and δ as point estimates from available data. The estimate for δ for a given year is determined by simply dividing the C_{EM} (cost of air pollution) of that year by the corresponding value Y. To derive the estimates of θ and λ, it is necessary to first demonstrate values that conform to information contained in the income accounts. These accounts are based on the following identity:

$$Y = CE + OS, \tag{A2}$$

where CE represents compensation to employees, namely the sum of payment to L and OS is gross operating surplus which is regarded as the sum of payments to KM

Hence equation (A2) can be used to describe a Cobb–Douglas production function of the form Y = f (KM, L}; that is

$$Y = \alpha KM^{\bar{\theta}} L^{\bar{\lambda}} , \tag{A3}$$

where $\bar{\theta}=\frac{OS}{Y};\bar{\lambda}=\frac{CE}{Y}$ and $\bar{\theta}+\bar{\lambda}=1$.

Because equation (A1) is deemed the valid descriptor for the distribution of Y, it is plausible to conclude that $\bar{\theta}$ and $\bar{\lambda}$ are overestimates for the factor shares Y in that they also include the income share that should accrue to KN, namely C_{EM}. It is possible to estimate the values θ and λ by assuming that the remainder of Y after accounting for C_{EM}, that is the amount (Y – C_{EM}) is distributed between KM and L in the proportion $\left(\bar{\theta}:\bar{\lambda}_A\right)$, where $\bar{\lambda}_A$ is based on the downward revision of CE to account for the presence of unemployment in the economy. Since point-estimate values of all coefficients and variables of equations (A1) and (A3) are known, the value of KN for each can be simply estimated through dividing equation (A1) by (A3).

Appendix: the estimation of KN (continued)

TableA1 Data on C_{EM} and Y

	South Korea		*Australia*		*USA*	
	C_{EM}	Y	C_{EM}	Y	C_{EM}	Y
1970	4,776,914	56,208,691	18,414	216,445	436,732	3,147,832
1971	5,063,529	61,024,268	18,958	224,161	444,983	3,237,887
1972	5,367,341	64,000,225	19,518	232,686	453,234	3,441,691
1973	5,689,381	71,897,926	20,095	243,819	461,485	3,653,524
1974	6,030,744	77,212,396	20,689	244,845	469,736	3,629,344
1975	6,392,589	82,257,194	21,300	248,665	477,987	3,604,617
1976	6,776,144	91,467,876	21,929	255,792	486,238	3,807,357
1977	7,182,713	100,621,533	22,577	258,102	494,489	4,009,418
1978	7,613,675	109,687,622	23,244	271,440	502,740	4,261,056
1979	8,070,496	117,434,685	23,931	277,143	510,991	4,392,742
1980	8,554,726	114,977,691	24,638	286,240	519,242	4,384,501
1981	8,979,331	122,412,257	24,793	292,684	506,894	4,491,426
1982	9,277,981	131,285,846	25,840	285,817	486,190	4,446,967
1983	9,794,146	145,330,534	25,490	301,609	485,377	4,582,017
1984	10,602,290	157,318,338	26,760	313,856	509,562	4,963,463
1985	11,472,853	167,501,865	27,963	327,449	507,796	5,165,850
1986	12,969,109	185,868,959	28,048	337,047	509,574	5,304,067
1987	14,248,650	206287161	29,234	353,328	526,163	5,540,180
1988	15,558,423	227,863,940	30,281	368,749	549,410	5,824,713
1989	16,755,460	241,725,520	31,721	383,662	561,978	5,951,937
1990	19,273,298	263,430,344	32,787	382,921	559,604	6,036,349
1991	21,872,661	287,737,881	32,998	384,312	560,081	6,001,167
1992	24,433,799	303,383,957	33,887	398,225	569,425	6,160,752
1993	28,350,362	320,044,251	34,910	411,268	580,858	6,309,815
1994	30,690,056	346,448,094	35,144	427,544	592,716	6,567,182
1995	33,821,344	377,349,800	36,524	443,787	605,480	6,784,000
1996	35,478,602	402,821,188	37,122	462,101	625,473	7,034,965
1997	37,804,958	423,006,790	40,468	484,396	628,435	7,361,741
1998	34,837,645	394,710,436	40,788	508,743	630,878	7,743,053
1999	37,346,825	437,709,377	42,711	529,444	641,661	8,084,094
2000	40,270,339	478,532,911	43,189	539,798	657,194	8,461,072

(All values in constant 1995 local currency units)