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MACROECONOMICS Vs ENVIRONMENTAL-MACROECONOMICS*

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ABSTRACT: This paper illustrates the differences in policy outcomes that would follow when environmental macroeconomic frameworks are employed in lieu of standard macroeconomic frameworks. The non-recognition of real environmental capacity constraints could explain, at least in part, the inability of policies derived from standard frameworks to deliver on certain macroeconomic goals, especially those pertaining to inflation. Herein environmental considerations are internalized into the analytic frameworks of factor-utilization, aggregate demand and aggregate supply. The analyses reveal restricted domains for national income and limited environmental capacity as potential sources of inflation. Hence environmental capacity expansion warrants specific attention. Illustrations are made with reference to the Australian economy and her response to global financial crisis over the period 2008-09.

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1. INTRODUCTION

Various reviews of developments in macroeconomics [for example Mankiw (2006); Chari and Kehoe (2006); and Gali and Gertler (2007)] fail to recognize environmental capital (KN) as a potential determinant of income, employment and inflation. The analytic frameworks considered in these reviews, besides those presented in standard texts (Blanchard 2008 and Taylor 2001), seem firmly rooted in confining the distribution of national income (Y) between labour (L) and manufactured capital (KM). The exclusion of KN in macroeconomics is not confined to the general macroeconomic literature alone. Even the literature on environmental economics (Cropper and Oates 1992; Stavins 2004) has the domain of policy analysis mainly focused on microeconomics. Hence the lament of Daly (1991) that environmental macroeconomics is an empty box. Nevertheless, the tradition of KN in macroeconomics dates back to Marshall (1891) who used the words “ultimate capital” – since the ultimate components of all items stem from nature. The origins of capital theory (Fisher 1904) itself owes acknowledgement to the premise that KN is a stock that generates a flow.

The main object of this paper is to demonstrate the significant differences that would emerge in policy formulation when environmental macroeconomic frameworks are employed relative to the standard frameworks. Towards this end, the method employed here is an ex-post analysis and involves the display of a sequence of snap-shots of the economy. Each snap-shot is a macroeconomic representation of the economy and this in turn is a manifest of the underlying framework employed. The display of a given snap-shot helps appreciate the types of decisions that need to be taken in anticipation of outcomes that would follow. The main contention herein is

that the utilization of the environmental macroeconomic framework could lead to significantly different sets of decisions.

The paper is structured as follows. The next section deals with an explanation of the analytic frameworks for both the standard and the environmental macroeconomic contexts. This is followed by an empirical illustration with reference to Australia. The Australian response to the global financial crisis (GFC) of 2008-2009 is employed to illustrate the variations in policy directives that would arise when different types of frameworks are employed.

2. THE ANALYTIC FRAMEWORK

The display of snap-shots is enabled by fitting point estimate data of the relevant time period to assumed functional forms that describe the macroeconomic frameworks. The standard macroeconomic representation consists of the joint display of aggregate demand (AD) – aggregate supply (AS), and a Cobb-Douglas (C-D) factor utilization framework. In the environmental macroeconomic representation, the above frameworks are revised for recognizing KN. In each instance, point estimate data are employed to construct the frameworks with the help of specific assumptions as illustrated below. The descriptions of the standard and environmental macroeconomic frameworks are next considered in turn.

The Standard Macroeconomic Framework

As indicated, some simplifying assumptions are made with reference to the description of AS, AD and C-D frameworks in order to facilitate the use of point estimate data. The C-D factor utilization framework is assumed to be one of constant returns to scale. In the context of a two-factor utilization framework involving

manufactured capital stock (KM) and labour (L) the standard expression for the C-D function is:

$$Y_t = \alpha_t \, KM_t^{\theta_t} \, L_t^{\lambda_t} \qquad (1)$$

Where θ_t and λ_t, represents the factor shares of national income (Y_t) in time t accruing respectively to KM and L; and owing to the assumption of constant returns to scale, ($\theta_t + \lambda_t$,= 1).

The assumption of constant returns to scale enables factors shares of income to be elicited directly from the income accounts where the following identity for Y prevails in terms of Compensation to Employees (CE) and Operating Surplus (OS):

$$Y_t \equiv CE_t + OS_t \qquad (2)$$

Because CE and OS represent respectively payments accruing to L and KM,

$$\theta_t = \frac{CE_t}{Y_t}; \qquad \lambda_t = \frac{OS_t}{Y_t} \qquad (3)$$

Given the point estimate data, say for time t, on KM_t and L_t, the estimation of the total factor productivity measure, namely α_t then follows. This C-D function can then enable the identification of capacity (full employment) income (Y_{Ft}) and the output gap (Y_{Ft}-Y_t) of this time period.

The exposition of AS is simplified by differentiating AS in terms of capacity supply (AS_F) and a short-run response (AS_{SR}). This differentiation made with reference to inflation rate (π), output (Y) and capacity output (Y_F) is as follows. For AS_{SR}, the premise is that in a given time period, say t and prices π_t, producers will strive to produce as much as possible ($Y \to \infty$) within that time period; that is:

$$AS_{SRt} : \left\{ (\pi = \pi_t) \,\middle|\, (Y \to \infty) \right\} \qquad (4)$$

At the other extreme, given that capacity in a given time period (t) cannot be exceeded, and should capacity (Y_{Ft}) be reached, then any further attempts at expansion would merely drive prices towards ∞; that is:

$$AS_{Ft}\left\{(Y = Y_{Ft})\,\middle|\,(\pi \to \infty)\right\} \qquad (5)$$

The exposition of AD is premised on the validity of the Quantity Equation, that is:

$$P_t\, Y_t = M_t\, V_t \qquad (6)$$

Where (P_t, M_t, V_t) represent respectively the price level, money stock and velocity in t.

In order to express AD in the form [$\pi_t = f(Y_t)$], an expression for P_t in terms of the inflation rate π_t becomes useful:

$$P_t = \pi_t\, P_{t-1} \qquad (7)$$

(In (7) the rate of (π) is scaled such that ($\pi = 1$) represents stationary price level).

Hence an expression for AD_t in terms of the quantity equation would read as:

$$\pi_t = \left[\frac{M_t\, V_t}{Y_t\, P_{t-1}}\right] \qquad (8)$$

The display of a given snap-shot and the elicitation of likely changes due to possible methods of intervention are further aided by the following set of simplifying assumptions:

1. For given observations π_t and Y_t in time t, we assume that a short-run equilibrium namely $\{AS_{SRt} = AD_t\}$ does exist for (Y_t, π_t).
2. The definition of money stock is confined to narrow money (M1). The changes in M1 in response to changes in the interest rate (r) are given by $\left(\frac{dM}{dr}\right)$. Given the ex-post nature of the analysis, the interest rate decisions are known.
3. Expenditure in a given time t (GDP_t) is defined in terms of fiscal policy in consumption (C) and government spending (G); and monetary policy through changes in additions to investment stock (ΔI).

4. Velocity of money during a given time period remains fixed at $\overline{V}_t$

Given the above assumptions the following definitions can be made and then elicited from the point-estimate data of relevant time periods.

Money Stock: $$M_t = \left[M_{t-1} * \left(\left(\frac{dM}{dt} \right) + \left[\left(\frac{dM}{dr} \right) * (\Delta r_{t-1}) \right] \right) \right], \qquad (9)$$

Where $(\Delta r_{t-1} = r_{t-1} - r_{t-2})$ is based on the appropriate point-estimates for the interest rates and $\left(\frac{dM}{dr} \right) = \left(\frac{dM/dt}{dr/dt} \right)$

Expenditure: $$GDP_t = \Phi_t + \beta_t Y_t (1 - \tau_t) + G_t + I_t \qquad (10)$$

Where Φ_t, β_t and τ_t, are respectively a constant comprising of net exports; marginal propensity to consume; and the taxation rate.

Investment : $$I_t = \left[I_{t-1} * \left(\left(\frac{dI}{dt} \right) + \left[\left(\frac{dI}{dr} \right) * (\Delta r_{t-1}) \right] \right) \right] \qquad (11)$$

Assembling (9) – (11) an expression for AD in time t could be provided as:

$$\pi_t = \left[\frac{M_t \overline{V}_t}{\left[\Phi_t + \beta_t Y_t (1 - \tau_t) + G_t + I_t \right] P_{t-1}} \right] \qquad (12)$$

The depiction of the snap shot will follow the display of (1), (4), (5) and (12) from the relevant point estimate data. The expected changes in the snap-shot for the subsequent period will be in part determined by (12) and the gradient of the AD function which is defined as:

$$\frac{\partial \pi}{\partial Y} = \left[\frac{-M_t \overline{V}_t \beta_t (1 - \tau_t)}{\left[\Phi_t + \beta_t Y_t (1 - \tau_t) + G_t + I_t \right]^2 P_{t-1}} \right] \qquad (13)$$

The important distinction between the standard framework and the environmental macroeconomic framework is captured in terms of at least two aspects. The first is the policy domain. That is, the income domain within which the policy maker will hope to seek a resolution for inflation and employment. As illustrated in Figure-1, this

domain for the standard framework is defined by ($Y_t \leftrightarrow Y_{Ft}$). The second aspect is the responsiveness of expenditure to inflation as exposited in (13).

As illustrated below, both these aspects will display variations within the environmental macroeconomic framework.

The Environmental Macroeconomic Framework

To illustrate this framework, suppose to begin with that KN and its cost of depreciation (D_{KN}) can be measured on the same scale as for KM in the national accounts. When KN is introduced in the description of factor utilization, (1) would be re-written as:

$$Y = \alpha_t \, KM^{\bar{\theta}_t} \, L^{\bar{\lambda}_t} \, KN^{\eta_t} \qquad (14)$$

In (14) which is deemed herein as the valid descriptor for factor utilization, η_t is the share Y that accrues to KN in time t and is defined in terms of D_{KN} as:

$$\eta_t = \frac{D_{KNt}}{Y} \qquad (15)$$

The distribution of Y between three factors, as per (14), instead of two factors as per (1), implies that $\left(\bar{\theta}_t < \theta_t\right)$ and $\left(\bar{\lambda}_t < \lambda_t\right)$. The retention of constant returns to scale in (14) further implies that $\left(\bar{\theta}_t + \bar{\lambda}_t + \eta_t = 1\right)$.

Further, if (14) is deemed the valid descriptor for the distribution of Y_t, it is plausible to conclude that θ_t and λ_t in (1) are over-estimates for the factor shares of Y_t because they also include the income share that should accrue to KN, namely D_{KNt}. To estimate the values $\left(\bar{\theta}_t, \ \bar{\lambda}_t\right)$ assume that the remainder of Y_t after accounting for D_{KNt} - that is, the amount ($Y_t - D_{KNt}$) is distributed between KM_t and L_t. Further assume that this distribution is in the proportion defined by the ratio of their shadow prices

(P_{KMt} and P_{Lt}). This is illustrated in (16) and (17) below. The reason for using this ratio is that the emergence of D_{KNt} as cost could be at least in part be due to the distortions in the markets for KM and L. Hence the coefficients $(\bar{\theta}_t, \bar{\lambda}_t)$ in (14) can be defined as follows:

$$\bar{\theta}_t = \left(\frac{OS_t - \left[\frac{P_{KMt}}{P_{KMt} + P_{LT}} \right] * D_{KN}}{Y_t} \right) \tag{16}$$

$$\bar{\lambda}_t = \left(\frac{CE_t - \left[\frac{P_{Lt}}{P_{KMt} + P_{Lt}} \right] * D_{KN}}{Y_t} \right) \tag{17}$$

As indicated below, the recognition of D_{KN} will result in the revision of expenditure to a more sustainable level, namely, ($Y_{tS} = Y_t - D_{KNt}$). Hence for achieving consistency with this revision, the income statement from factor utilization can be revised as follows:

$$Y_t - D_{KN} = Y_{tS} = (1 - \eta_t) * \left\{ \alpha_t \, KM^{\bar{\theta}t} \, L^{\bar{\lambda}t} \, KN^{\eta_t} \right\} \tag{18}$$

Since point-estimate values of all coefficients and variables of (1) and (18) are known either through estimation or reported data, the value of KN for each year can be simply estimated through dividing (1) by (18) as in Thampapillai (2007) and Thampapillai and Thangavelu (2005). Hence KN would be defined as:

$$KN_t = KM_t^{\left(\frac{\theta_t - \bar{\theta}_t}{\eta_t} \right)} L_t^{\left(\frac{\lambda_t - \bar{\lambda}_t}{\eta_t} \right)} \tag{19}$$

When all arguments in (18) are known, it is possible to revise the values of observed and capacity income (Y_t, and Y_{Ft}) towards values that recognize the role of KN. These are identified in Figure-1 as Y_{tS} and Y_{FtS}. Hence capacity AS would be redefined as:

$$AS_{Ft}\left\{(Y = Y_{FtS}) \,\middle|\, (\pi \to \infty)\right\} \tag{20}$$

The short-run supply response is also revised as:

$$AS_{SRt}\left\{(\pi = \bar{\pi}_t) \,\middle|\, (Y \to \infty)\right\} \tag{21}$$

The size of $\bar{\pi}_t$ in (21) is likely to be higher than π_t in (4) capturing the role of KN as a potential cause of inflation. The coordinates of the short run equilibrium for $\{AS_{SRt} = AD_{tS}\}$ is revised as $(Y_{tS}, \bar{\pi}_t)$. Note that AD_{tS} represents the revised description of AD in the context of recognizing KN. Following Thampapillai and Uhlin (1997), D_{KN} is internalized into AD by redefining aggregate expenditure in (10) as:

$$GDP_t = \beta_t Y_t (1-\tau_t)(1-\eta_t) + \{(1-\eta_t)[\Phi_t + G_t + I_t) \tag{22}$$

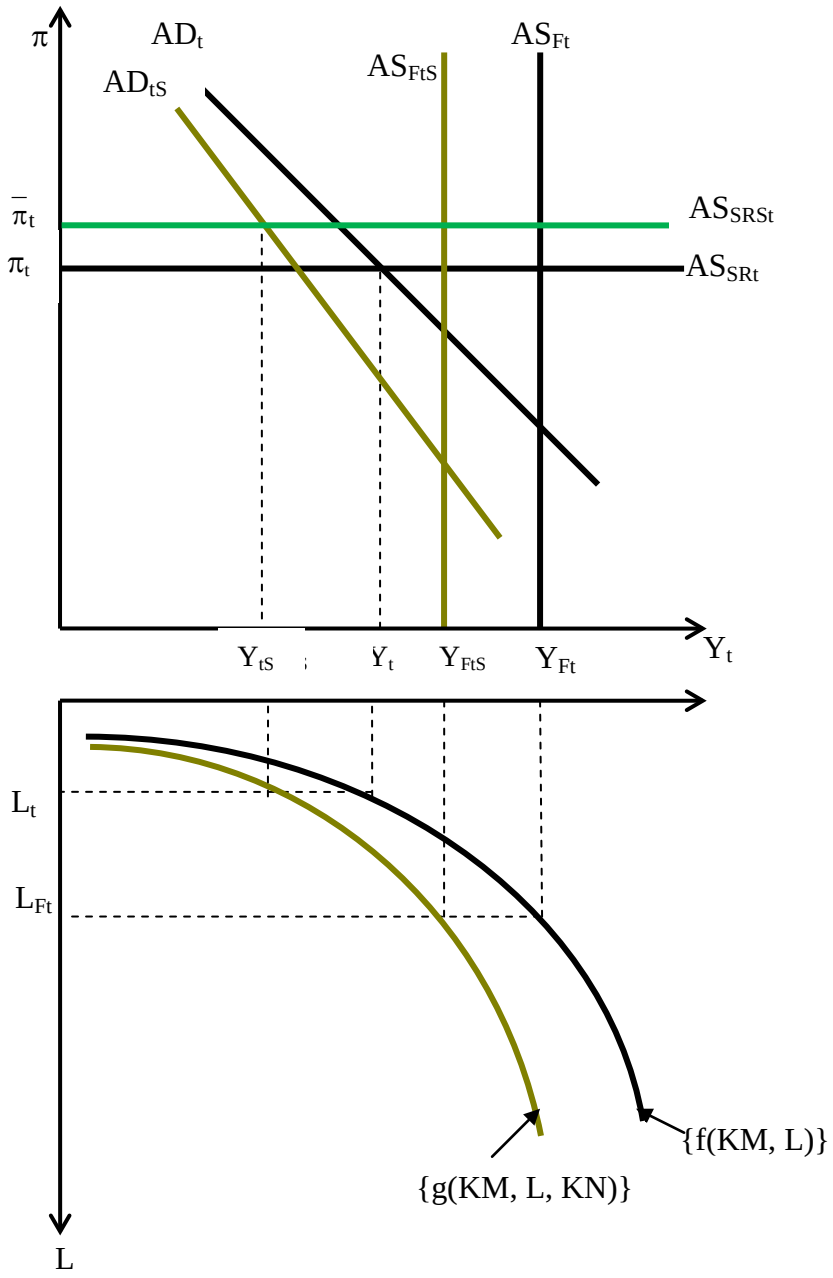
Hence the revised definitions for AD:

$$\pi_t = \left[\frac{M_t \bar{V}_t}{\left[\beta_t Y_t (1-\tau_t)(1-\eta_t) + \{(1-\eta_t)[\Phi_t + G_t + I_t)\right] P_{t-1}}\right] \tag{23}$$

The depiction of the snap shot will follow the display of (18), (20), (21) and (23) from the relevant point estimate data. As with the standard framework, the expected changes in the snap-shot for the subsequent period will be in part determined by (23) and the gradient of the AD function which is defined as:

$$\frac{\partial \pi}{\partial Y} = \left[\frac{-M_t \bar{V}_t \beta_t (1-\tau_t)(1-\eta_t)}{\left[\beta_t Y_t (1-\tau_t)(1-\eta_t) + \{(1-\eta_t)[\Phi_t + G_t + I_t)\right]^2 P_{t-1}}\right] \tag{24}$$

The two types of frameworks described above are illustrated in Figure-1.



3. THE ILLUSTRATION

As indicated, in this ex-post analysis two types of snap-shots, namely *expected* and *actual* snap-shots are generated following the initial snap-shot for each type of framework. Policy intervention is confined to monetary and fiscal measures. As indicated below these interventions can be ascertained from national accounts and the minutes of the Reserve Bank of Australia that are accessible on the public domain. Pertinent quarterly data for the period 2001-Q1 to 2010 Q-2 were drawn from the

OECD e-library. The display of snap-shots commences with the last quarter of 2007 because vastly different types of intervention measures were adopted subsequent to this period because of the GFC. The final period for the display is 2010-Q2.

It is assumed that the development of the expected snap-shot for a subsequent time period, say (t+1), would follow a sequence of steps as outlined below:

1. Identification of the state of the economy in terms of output, employment and inflation gaps

2. Estimation of output response (Y_{t+1}) to fiscal and monetary intervention measures by recourse to application of definitions of GDP – (10) and (22) above

3. Estimation of employment (L_{t+1}) that corresponds to (Y_{t+1}) by recourse to the application of the factor utilization functions – (1) and (18)

4. The estimation of the full employment level (L_{Ft+1}) by recourse to the trend in labour force growth and the value of capacity income (Y_{Ft+1}) by recourse to factor utilization functions – (1) and (18). This would enable the display of capacity AS for (t+1).

5. Estimation of (π_{t+1}) and (π_{Ft+1}) that correspond to (Y_{t+1}) and (Y_{Ft+1}) by recourse to the application of AD functions – (12) and (23)

6. Display of output, employment and inflation gaps for (t+1)

Within the above sequence, in the absence of any policy intervention, the exposition of the expected snap-shot is guided by the estimation of (d/dt) for pertinent variables and coefficients. For example, consider (9) above. In the absence of any monetary policy intervention the change in Mt is assumed to be guided solely by (dM/dt). The (d/dt) values estimated for the analysis are summarized in Table A-1 in the appendix. Figure A-2 presents an over-view of the basis for generating expected values.

For the illustration of the environmental macroeconomic framework, D_{KN} is confined to the cost of CO2 pollution abatement. CO2 emission data was drawn from the World Development Indicators for Australia and an emission expenditure of USD 100/tone was used as per the Stern (2007) report. Further, the estimation of $\left(\bar{\theta}_t,\ \bar{\lambda}_t\right)$

in the environmental macroeconomic framework requires the estimation of shadow prices for KM and L. Following the standard traditions of cost-benefit analysis, P_{KMt} is approximated to the long-term government bond rate. P_{Lt} is estimated as a capital equivalent price of L. For this purpose, CE is adjusted downwards to reflect the prevailing rate of unemployment. To obtain this adjusted value, CE_{St}, first an average wage rate that would support full employment in period t, W_{St}, is estimated – for example through dividing CE by the labour force. CE_{St} is then defined by $(W_{St}*L_t)$, where L_t is the actual workforce. P_{Lt} as a capital equivalent price is then defined as (CE_{St}/KM_t). Since intervention is limited to monetary and fiscal measures, the anticipated changes are captured by recourse to changes in (12), (13), (23) and (24). The intervention measures in terms of interest rates (r), taxation rate (τ) and government spending (G) are summarized in Table-1

Table-1: Monetary and Fiscal Intervention Q4-2007 to Q2-2010

	Δr	G	τ
Q4-2007	0.25	39.02	0.12
Q1-2008	0.47	39.49	0.12
Q2-2008	0.03	40.44	0.11
Q3-2008	-0.23	40.83	0.11
Q4-2008	-2.67	41.53	0.11
Q1-2009	-1.10	41.76	0.11
Q2-2009	-0.25	42.05	0.11
Q3-2009	0.00	42.92	0.11
Q4-2009	0.74	43.67	0.11
Q1-2010	0.24	44.37	0.11
Q2-2010	0.52	45.17	0.11

The observed and expected values with reference inflation, output and employment are summarized in Table-2 below. These three categories are considered in turn below.

Table-2 Summary of Observed and Expected Outcomes

	π_t (percentage)				π_{Ft} (percentage)			
	STD Framework		EME Framework		STD Framework		EME Framework	
	obs SFW	Exp SFW	Obs EMFW	Exp EMFW	obs SFW	Exp SFW	Obs EMFW	Exp EMFW
Q4-2007	1.007	1.007	1.175	1.175	0.908	0.904	1.071	1.071
Q1-2008	1.010	1.011	1.174	1.178	0.912	0.904	1.074	0.919
Q2-2008	1.002	1.014	1.155	1.181	0.911	0.903	1.055	0.922
Q3-2008	1.004	0.999	1.149	1.162	0.913	0.904	1.052	0.909
Q4-2008	0.993	0.993	1.140	1.153	0.910	0.901	1.042	0.904
Q1-2009	1.007	0.961	1.163	1.112	0.905	0.895	1.058	0.876
Q2-2009	1.005	0.927	1.176	1.069	0.903	0.866	1.066	0.845
Q3-2009	1.003	0.914	1.172	1.053	0.903	0.852	1.062	0.834
Q4-2009	1.010	0.911	1.180	1.049	0.905	0.846	1.071	0.832
Q1-2010	1.007	0.916	1.170	1.054	0.908	0.843	1.066	0.837
Q2-2010	1.012	0.922	1.167	1.060	0.908	0.846	1.063	0.843

	Y_t (Year 2000 $ Billion)				Y_{Ft} (Year 2000 $ Billion)			
	STD Framework		EME Framework		STD Framework		EME Framework	
	obs SFW	Exp SFW	Obs EMFW	Exp EMFW	obs SFW	Exp SFW	Obs EMFW	Exp EMFW
Q4-2007	204.09	204.09	174.87	174.87	224.66	224.66	191.86	191.86
Q1-2008	207.21	205.63	178.25	176.36	227.14	227.25	194.77	226.21
Q2-2008	213.34	207.19	185.14	177.82	234.20	229.88	202.61	227.78
Q3-2008	219.47	212.86	191.76	182.93	240.44	232.56	209.41	233.87
Q4-2008	220.00	216.00	191.53	185.92	241.71	235.29	209.64	237.16
Q1-2009	217.32	224.33	188.12	194.02	240.09	238.07	206.95	246.14
Q2-2009	212.17	227.67	181.40	197.42	234.97	240.89	200.11	249.64
Q3-2009	214.13	229.91	183.25	199.65	237.21	243.77	202.24	251.95
Q4-2009	215.91	231.89	184.95	201.59	238.69	246.70	203.72	253.95
Q1-2010	219.97	232.60	189.31	202.25	242.14	249.69	207.67	254.56
Q2-2010	226.07	234.69	196.02	204.23	249.01	252.72	215.17	256.68

	L_t (Million Persons)				L_{Ft} (Million Persons)			
	STD Framework		EME Framework		STD Framework		EME Framework	
	obs SFW	Exp SFW	Obs EMFW	Exp EMFW	obs SFW	Exp SFW	Obs EMFW	Exp EMFW
Q4-2007	9.43	9.43	9.43	9.43	11.25	11.25	11.25	11.25
Q1-2008	9.55	9.49	9.55	9.49	11.31	11.31	11.31	11.31
Q2-2008	9.58	9.55	9.58	9.55	11.39	11.37	11.39	11.37
Q3-2008	9.65	9.61	9.65	9.61	11.45	11.43	11.45	11.43
Q4-2008	9.67	9.67	9.67	9.67	11.50	11.49	11.50	11.49
Q1-2009	9.64	9.73	9.64	9.73	11.59	11.56	11.59	11.56
Q2-2009	9.66	9.79	9.66	9.79	11.64	11.62	11.64	11.62
Q3-2009	9.67	9.85	9.67	9.85	11.67	11.68	11.67	11.68
Q4-2009	9.73	9.91	9.73	9.91	11.73	11.74	11.73	11.74
Q1-2010	9.85	9.98	9.85	9.98	11.80	11.81	11.80	11.81
Q2-2010	9.87	10.04	9.87	10.04	11.86	11.87	11.86	11.87

Legend: SFW = Standard Framework; EMFW = Environmental Macroeconomic Framework

Inflation

Consider first the observation with reference to π_t; (Figure-2). Both the expected and observed values of inflation elicited from the environmental macroeconomic framework are consistently higher than those from the standard framework.

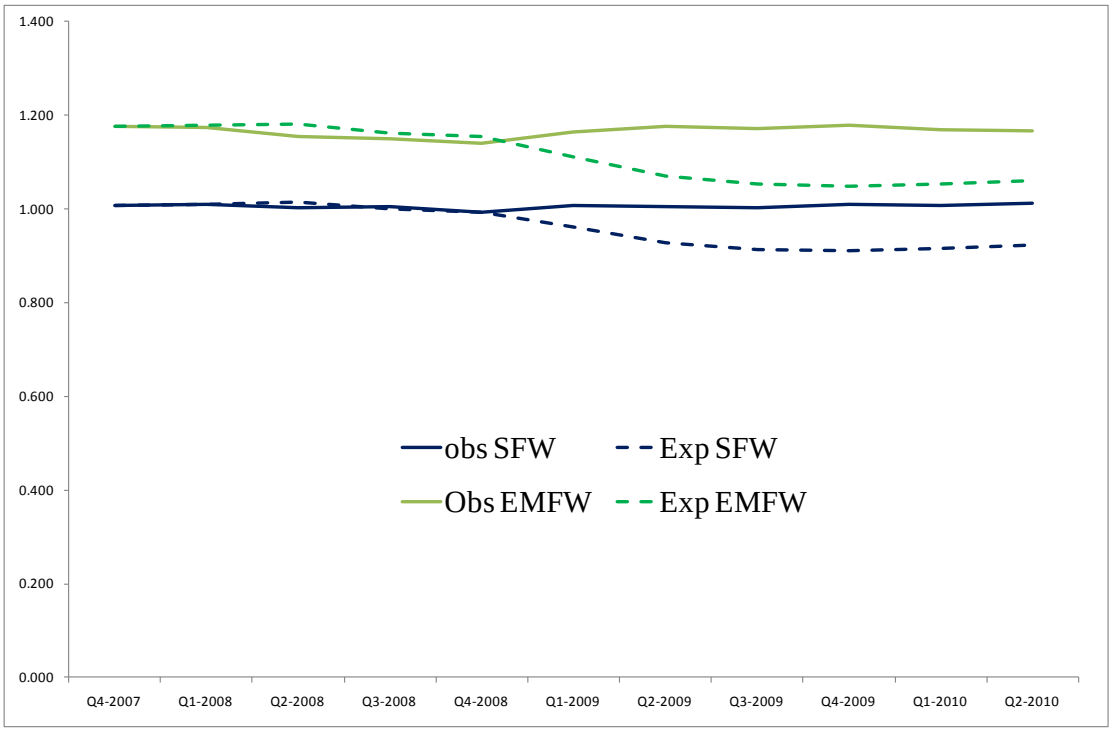


Figure-2: Observed Vs Expected Inflation Levels (Q4-2007 to Q2-2010)

Although the expectations were to achieve lower levels of inflation – the observed values of inflation remained steady despite the varying intervention (tightening as well as loosening) measures adopted by the RBA. A reading of the minutes of the RBA's deliberations, during the first half of the period under review reveals an expressed concern with inflationary forces and pressures on productive capacity. Hence the RBA steadily raised interest rates up until the third quarter of 2008. The highest increase was in the first quarter of 2008 (0.47 percentage points). For example the minutes of the February 2008[1] meeting contain the following excerpt with reference to the period leading up to the meeting:

"Demand remained strong and capacity utilization remained high with persistence in labour shortages …"

[1] http://www.rba.gov.au/MonetaryPolicy/RBABoardMinutes/2008/rba_board_min_05022008.html

This meeting resulted in the raising of the interest rates by 25 percentage points. A comparison of the snap-shots for Q4-2007 derived from the standard and environmental macroeconomic frameworks quite clearly shows presence of an environmental capacity constraint which was not recognized. As such, the rate increase might have been unwarranted and various efforts to enhance environmental capital capacity might have been order. The case for this argument is illustrated in Figure-3. Note that the observed level of Y in the standard framework ($Y_{Q4\text{-}07}$ = 204.09) exceeds the capacity level of Y in the environmental macroeconomic framework ($YF_{Q4\text{-}07}$ = 191.86). That is, KN capacity is an unrecognized driver of inflation.

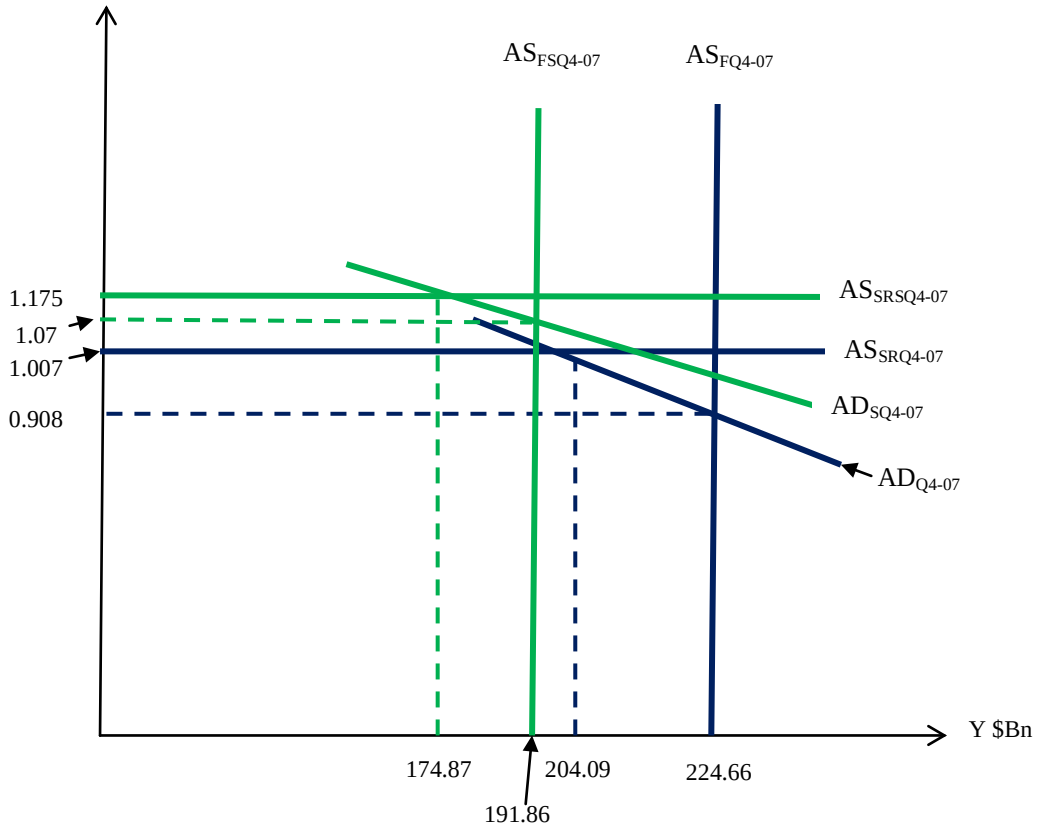


Figure-3: Snap-Shot of AS-AD Framework (Q4-2007)

A closer scrutiny of Table-2 reveals that ($Y_t > Y_{FSt}$) for all time periods considered here. Further, the analysis here has been confined to CO2 pollution abatement. The

capacity restriction would undoubtedly be more severe when all other sources of KN degradation such as toxic contamination of land and water resource systems and loss of forestry due to bush fires are recognized.

Income and Output

A comparison of incomes (Figure-4) reveals that the observed income paths for both Y_t and Y_{tS} were in excess of their corresponding expected trajectory until Q4-2008.

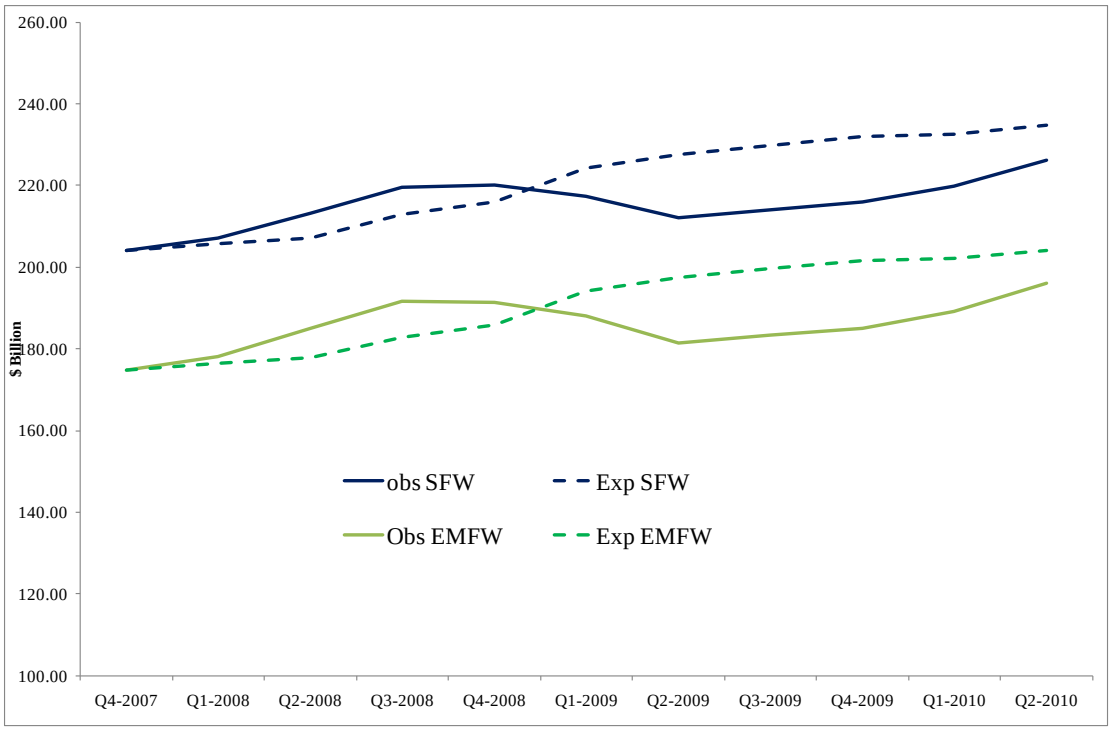


Figure-4: Observed Vs Expected Income Levels (Q1-2007 to Q2-2010)

The effects of the GFC were realized during Q3-2008 when the observed income paths began their decline. Despite the activation of the stimulus package and the relaxation of monetary policy, the observed path had not managed to reach the expected trajectory. Two observations from Figure-4 are worthy of mention:

1. The decline in Y_t that was prompted by the GFC did not propel it below Y_{tS} or even the corresponding expected trajectory of Y_{tS}. The rescue measures were put in place well before this could happen – primarily because there was a clear lack of appreciation of KN and its role.
2. The rescue measures themselves could have been better articulated towards lifting the paths of Y_{tS} rather than Y_t.

The issue is —the rescue packages strove to return economies to the unhealthy pre-crisis state. The debate on these packages coincided with leading scientists on the Intergovernmental Panel on Climate Change (IPCC), claiming that IPCC had underestimated the climate risks; (Berger 2009) and a compelling statement by Arrow et al. (2009) on the seriousness of climate change. All the more reason that the rescue packages could have been fine tuned. The financial crisis presented an opportunity for the government to restructure the economy and navigate it towards sustainable incomes and modest lifestyles. Focus could have shifted to ventures such as:

- Expanding public transport (instead of car manufacturing plants and roads);
- Developing renewable and low green house emission technologies instead of further exploration of fossil fuels; and
- Facilitating innovative methods and closed-loop production systems that reuse wastes and emissions – (for example reusing the heat emissions of air-conditioners in economic activities).

Employment and Wages

Table-3 provides the information on compensation of employees and corresponding average (quarterly) wages across the eleven quarters considered in terms of both frameworks.

Table-3: Employment and Wages

L	CE	CE_S	W	W_S	ΔW
9.428	204.09	191.86	21648	20350	0.060
9.545	207.21	194.77	21708	20405	0.060
9.582	213.34	202.61	22266	21146	0.050
9.645	219.47	209.41	22754	21711	0.046
9.665	220.00	209.64	22762	21690	0.047
9.643	217.32	206.95	22537	21461	0.048
9.662	212.17	200.11	21960	20712	0.057
9.670	214.13	202.24	22144	20915	0.056
9.733	215.91	203.72	22184	20932	0.056
9.851	219.97	207.67	22329	21080	0.056
9.870	226.07	215.17	22904	21800	0.048

The final column portrays the percentage of wage reduction that is required for compliance with the outcomes of the environmental macroeconomic framework. This reduction ranges between 5 and 6 percent. However, such wage reduction across the board may not be pertinent. This is because as in most OECD economies, Australia had been experiencing a growing income divide. For example, Atkinson and Leigh (2006)] report that in 2002:

- The richest ten percent held nearly thirty one percent of national income
- Annual wages of CEOs on average exceeded Three to Four Million Australian Dollars
- The richest two hundred persons held nearly two percent of national income in 2001.

The irony is that the over-heating in Australia (as in many other countries) which prompted contractionary interventions during the first half of the period considered was perhaps driven by the smaller (richer) section of the community in at least three ways.

a. The first was pervasion of asymmetric information and the quest for higher wages by principal agents — In Australia one bank CEO received a bonus payment of Thirty One Million Australian Dollars in 2008 — There are several narratives of this vein across the globe and given the extent of the shares of income, National Income Statisticians could even include a CEO sector in their classification codes.
b. The second was the diversification into the formulation and delivery of risky products and services (especially in those sectors where the CEOs commanded high wages) — mainly to justify and sustain higher wages. Here again asymmetric information had played a role. A reading of the minutes of the RBA board meeting (mentioned above) gives the impression that the board was not fully cognizant of Australia's exposure to the US sub-prime crisis in February 2008, and this in turn implies limited information flows from the major financial market players to the RBA.
c. The third was the rapid proliferation of ancillary services that specialized in extravagances in recognition of the higher wages; for example luxury charter airlines; and expensive holiday resorts and packages. Many of these ancillary services made intensive use of environmental resources. The rapid growth in the ancillary services has no doubt accelerated environmental degradation and climate risks. For example, ask the question — "Why did Airbus deliver the A-380 with individual cabins and ensuites"? — Answer: It perceived a clear demand from the airlines, which in turn perceived a sustained growth in

> demand for elite class travel. The notion that the expansion of such air travel would deliver significant green house gas emission loads seems to have gone unnoticed.

The rescue effort should have been also guided by a clear wages policy that dictates wage to equal its true (social) opportunity cost and not a contrived estimate. This may be viewed as an impediment to the functioning of a free market. But, the GFC was not the result of a free market. It was the result of an imperfect market shrouded by the lack of transparency – mainly with reference to the accounting of investments which rendered economic performance to be over-stated.

4. CONCLUSION

There are of course other pertinent areas of macroeconomic policy analysis. These include the size of the multipliers (Barro 2009) and effective means for ensuring spending (Barnett 2009) in the context of stimulus packages. Note that the size of the multiplier with the environmental macroeconomic framework would be smaller than that elicited from the standard framework. Counter to Barnett's (2009) arguments for suggestions for enhancing spending, it is prudent to argue for dedicated incentives for public transport and renewable energy choices. Finally, one should bear in mind that in the money-velocity relationship with national product and inflation KN is a true determinant of national product. Then, the multipliers and expected velocities of the rescue injection, estimated without any reference to KN would be truly Voodoo – to borrow Professor Barro's (2009) terminology

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APPENDIX

Table A-1: (d/dt) Values for Pertinent Variables and Coefficients
(Based on quarterly data Q1-2001 to Q2-2010)

Variable or Coefficient	(d/dt)
λ_t	0.998
θ_t	1.002
α_t	1.004
Φ_t	1.0015
β_t	0.996
I_t	1.0114
G_t	1.011
M_t	1.0416
P_t	1.0076
V_t	1.0011
KM_t	1.0125
L_t	1.0063
L_{Ft}	1.0054
P_{KMt}	0.992
r (+)	1.0517
r (-)	0.922

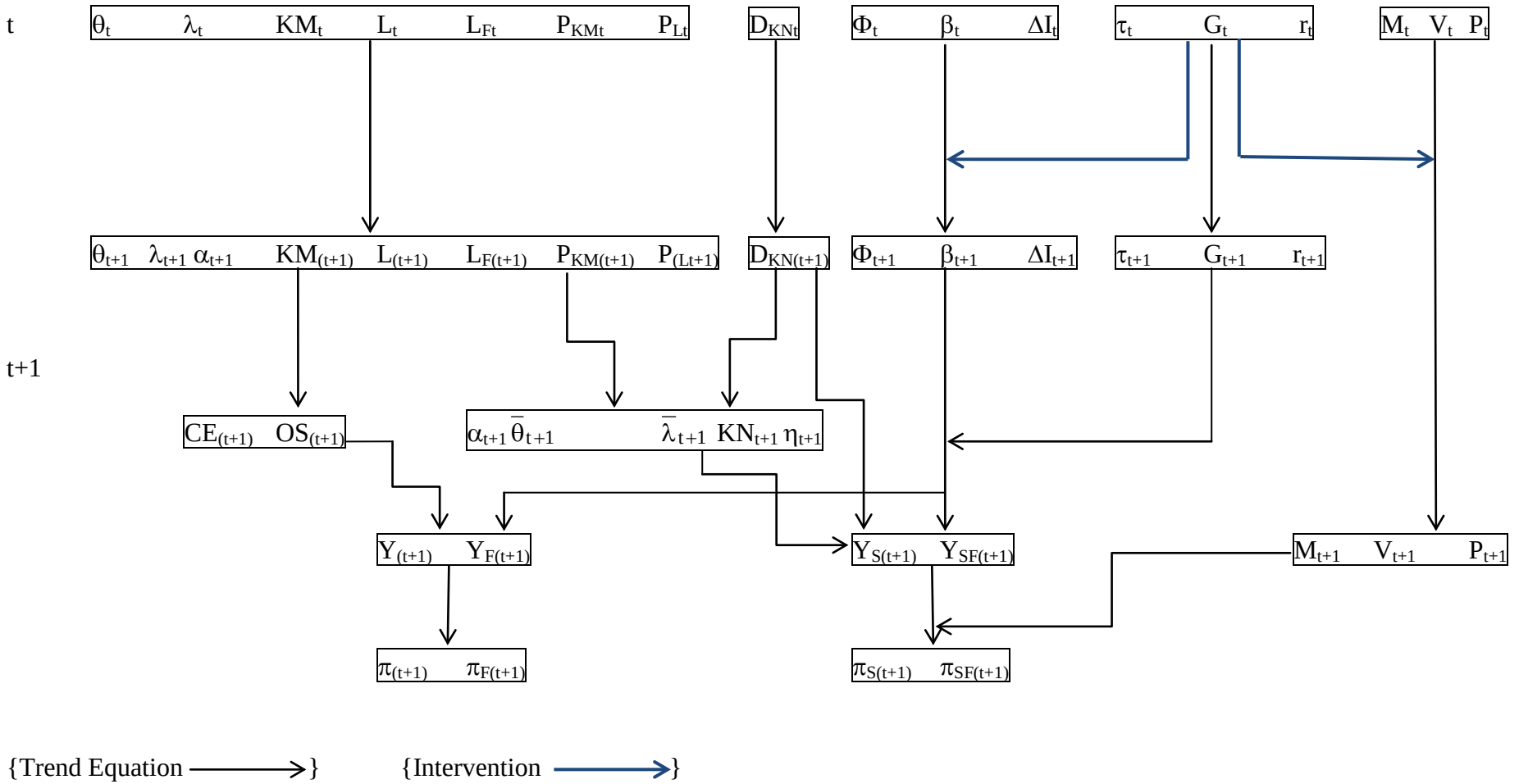

Figure-A1: The Framework for Projections and Expected Snap-Shots