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SOCIAL SECURITY: NATIONAL POLICIES WITH INTERNATIONAL IMPLICATIONS*

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Social security policies within individual countries are determined independently by national governments, but the resulting outcome is inefficient compared with what would result from the international co-ordination of policies. This is because national social security policies produce international externalities via their effects on world interest rates. An illustrative example suggests that the gains from co-ordination are potentially significant.

Virtually all countries operate social security (or redistributive) policies. Each chooses policies independently, and to my knowledge no-one, either in a policy-making context or in the large literature on international policy co-ordination, has suggested that such decisions would benefit from international co-ordination.[1] However, a simple argument suggests that independent national social security policies are inefficient: more specifically, in the long run *national governments make policy decisions which are too egalitarian.* This holds provided that social security lowers national saving. In this case, each national government faces a trade-off between income redistribution and national saving, and can be assumed to locate at the nationally optimal point on this trade-off, taking as given the world interest rate. The latter is clearly not independent of the combined effect of all countries' policies, however: if all countries expand social security, the resulting fall in world saving will raise the world interest rate, with adverse consequences for each national economy. Each country rationally ignores its own (small) contribution to the global outcome. If this international externality were internalised by co-ordination, countries would relocate on the trade-off between income redistribution and national saving.

Demonstrating the existence of an externality says nothing about its quantitative significance. I address this with an example which focuses on pay-as-you-go (PAYG) retirement pensions in an economy with a mixture of forward-looking and myopic individuals. The pensions prevent destitution among retired myopes and thus effectively redistribute life time welfare, but they also lower saving because of PAYG financing. For all parameter values considered, international co-ordination of pensions policy decisions generates welfare gains which are larger – for many parameter values substantially larger – than recent estimates of the welfare gains from either the entire elimination of all cyclical fluctuations, or the reduction of inflation and nominal interest rates from sub-optimally high to optimal levels. Hence the issues addressed in the paper are quantitatively significant when judged against other frequently-advocated

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[1] Fischer (1988), Frenkel *et al.* (1990) and Kenen (1990) provide useful surveys of the literature on policy co-ordination.

macroeconomic policy objectives. This suggests a strong case for shifting the focus of analysis of social security policies away from the closed economy context of most current work. For example, Feldstein (1996), and the four papers in the *American Economic Review* Papers and Proceedings 1996 symposium on 'Reforming Social Security' (Gramlich, 1996; Mitchell and Zeldes, 1996; Kotlikoff, 1996; and Schieber and Shoven, 1996) all implicitly or explicitly consider a single closed economy, even though a common theme of all the papers is that social security reform is needed in most countries. Hence if each country were to alter its policies, the outcome would be different from the papers' predictions because the latter ignore international spillovers. Since governments in many countries are under pressure, for a mixture of political and/or economic reasons, to reduce public expenditure on social security programmes, this is an issue of immediate practical importance. It is also important in the context of continuing discussions about economic integration and federal structures. For example, the prospect of EMU within the European Union has led to growing discussion about the scope for, and effects of, closer cross-national co-operation in various policy contexts. The paper's argument suggests that social security could be one such context in which co-operation pays off.[2]

The rest of the paper is organised as follows. Section 1 presents the basic argument in general terms. This is augmented in sections 2 and 3 with a detailed illustrative example. Section 4 concludes.

1. Social Security Policies

1.1. *The Framework*

I consider a world with many identical economies. There is perfect capital mobility. The world interest rate, r, equates world saving and investment, and thus adjusts in response to changes in world saving, but each individual country is sufficiently small that changes in its national savings rate have a negligible impact on r. There is a single good, produced in each country, whose world price is given to each individual country; this good can be costlessly transformed between consumption and capital. Firms in each country, operating in competitive markets, equate their marginal products of capital to r; hence for given technical knowledge, capital intensity and average *per capita* income vary inversely with r. Changes in world saving thus generate changes in the same direction in capital intensity and *per capita* income in every country. Changes in any one country's national saving leave its capital intensity unaffected but they still alter its sustainable *per capita* income, in this instance via changes in its current account and thus in its net stock of foreign assets. There is no uncertainty. Consumers have finite lives and make no bequests. Obstfeld and Rogoff (1996, pp. 156–60) and Milbourne (1997) provide examples of such a framework.

[2] The paper's arguments are formulated at the level of the world economy as a whole, whereas the European Union is one large regional grouping within the world economy. The paper's conclusions would apply in a modified form in this latter context.

1.2. *Social Security*

I define social security as the use of current tax revenue to finance transfers to individual consumers, (e.g. retirement pensions, unemployment benefit, and payment of medical expenses). If such policies were withdrawn or scaled down, consumers (unless myopic) would increase saving to guard against such contingencies. Hence the pay-as-you-go (PAYG) nature of social security reduces saving.[3] It can be argued that all PAYG schemes are sub-optimal and should be replaced by funded schemes,[4] but in this paper I take their continued existence for granted.

1.3. *National Social Security Policies*

PAYG social security schemes are thus used by national governments seeking to maximise national social welfare functions. Following Atkinson (1989, ch. 2) I assume that the social welfare function is increasing in average *per capita* income and decreasing in a measure of the cost of income inequality and/or the cost of poverty. For any country i I define a single social security policy instrument, T_i, such that $T_i = 0$ if no policy is implemented, and increases in T_i denote increased transfers.[5] An increase in T_i thus reduces (suitably measured) inequality, but because it requires increased PAYG taxes, it also reduces national saving, and therefore average *per capita* income. The government chooses T_i so as to locate at the optimal point on this trade-off. For country i the steady state social welfare function can be written in indirect form as:[6]

$$V_i = V_i(T_i, r), \ \partial V_i/\partial r < 0. \tag{1}$$

T_i and r jointly determine both average income and income distribution. $\partial V_i/\partial r < 0$ because as explained above, average income *per capita* in each country varies inversely with r.[7] The government takes r as given,[8] and chooses T_i^* such that:

$$\partial V_i(T_i^*, r)/\partial T_i = 0. \tag{2}$$

1.4. *Global Implications*

T_i^* is the nationally optimal social security policy. Since all countries are identical, all make the same choice, and T_i^* is the Nash equilibrium policy. However, it is not globally optimal. The world interest rate can be written:

[3] Depending on model specification, it may also reduce labour supply.

[4] E.g. Feldstein (1996) and Kotlikoff (1996) argue this with respect to retirement pensions.

[5] A rise in T could denote, e.g. an increase in the size of transfers for given circumstances (e.g. unemployment, etc.) or an extension of coverage to contingencies not previously covered by social security.

[6] Since the countries are all the same, $V(.)$ has the same form in all of them, though this is not essential.

[7] Insofar as the degree of income inequality varies with r it presumably does so directly, which is also consistent with $\partial V_i/\partial r < 0$.

[8] Each country has a tiny effect on r. For simplicity, this is ignored in (2) and throughout the paper.

$$r = r(T), \quad r'(T) > 0. \tag{3}$$

T is an international country-weighted average of national policies. Increases in T indicate net world expansions of social security, and the resulting fall in world savings raises r. A globally optimal policy would take account of (3). Substituting in (1) and differentiating gives the globally optimal policy T^{**}:

$$\frac{\partial V_i[T^{**}, r(T^{**})]}{\partial T_i} + \frac{\partial V_i[T^{**}, r(T^{**})]}{\partial r} r'(T^{**}) = 0. \tag{4}$$

Since the second term in (4) is negative, $\partial V_i / \partial T_i > 0$ at the steady state global equilibrium: hence $T^{**} < T^{*}$. Fig. 1 illustrates. It indicates that national governments, acting in isolation, choose social security policies which are too egalitarian in terms of the trade-off between average income and income inequality.

2. An Illustrative Example

This section applies the previous section's argument to Feldstein's (1985) analysis of the use of PAYG pensions to safeguard the retirement income of

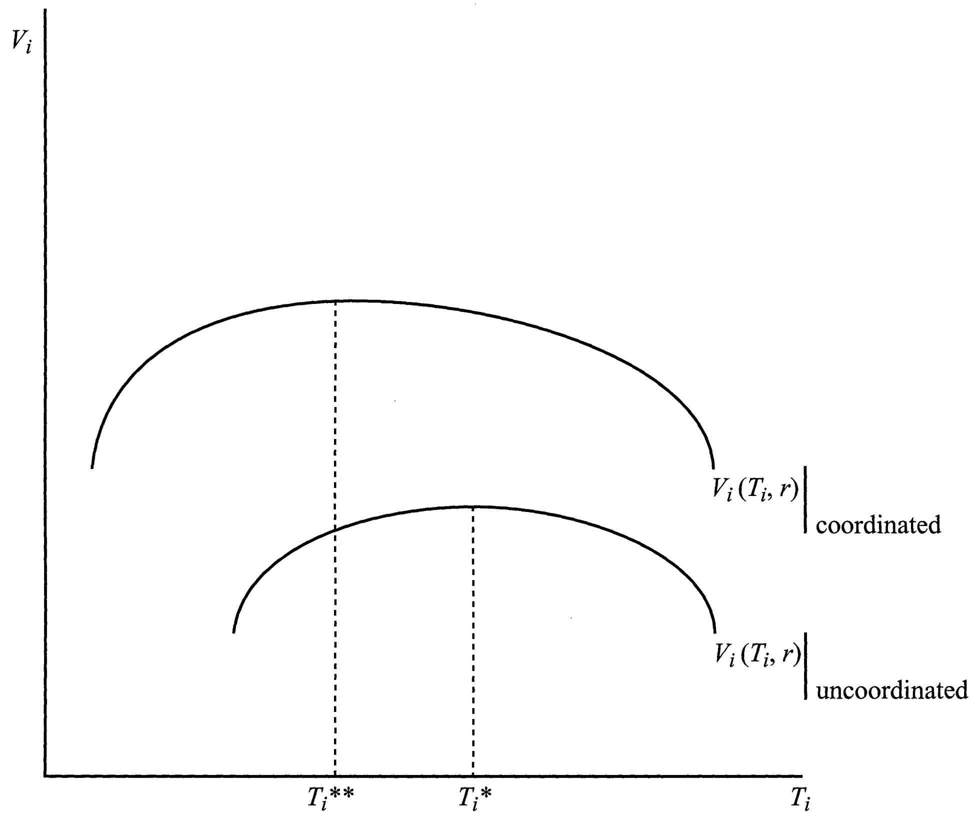

Fig. 1. *National and Global Social Security Optimisation*

individuals who are too myopic to save during working life. This is an appropriate illustrative example because as Feldstein (1985, p. 303) emphasises, it involves an explicit trade-off between income distribution objectives and average income objectives. Also, the need to protect people from the consequences of their myopia is often advanced as an argument for PAYG pensions (Dilnot *et al.*, 1994).

2.1. *Technology and Capital Accumulation*

Within each economy, the representative firm i has the following production function:

$$Y_i(t) = Y(t)^e A(t)^{1-a} K_i(t)^a L_i(t)^{1-a}, \; 0 < a < 1, \; e \geqslant 0,$$

$$A(t) = \mathrm{G}^t A(0), \; L(t) = \mathrm{N}^t L(0). \tag{5}$$

$Y_i(t)$, $K_i(t)$ and $L_i(t)$ are firm i's output and its capital and labour inputs, and $Y(t)$ is aggregate output. $A(t)$ denotes technical knowledge which affects all firms and which grows at an exogenous rate $(G-1)$ per period; the aggregate labour force $L(t)$, and population, grow at rate $(N-1)$ per period. If $e = 0$ (5) is a conventional constant returns Cobb-Douglas production function. If $e > 0$ there are externalities in production: increased output in any one firm contributes to higher aggregate output which in turn raises output in other firms for given input levels in the latter. This possibility reflects recent research findings for manufacturing industry in Europe, the United States, and the United Kingdom (Caballero and Lyons, 1990, 1992; Oulton, 1996*a*); all three studies find statistically significant positive values for e. Caballero and Lyons (1992, p. 21) interpret these findings as reflecting thick market externalities (as aggregate activity expands it becomes easier to identify profitable inter-firm transactions). An alternative interpretation might be that as individual firms expand, they generate new knowledge whose benefits they cannot keep for themselves. Spillovers of knowledge and/or of learning by doing are familiar in growth models (e.g. Arrow, 1962; Romer, 1986).[9] I interpret 'capital' as physical capital, but also briefly note the implications of following Mankiw *et al.* (1992) and Barro *et al.* (1995), who define K more broadly to include human as well as physical capital.[10] Both the interpretation of 'capital' and the existence and interpretation of externalities remain empirically unsettled issues. It should therefore be emphasised that the basic theme of the paper does not depend on any one specification of the production function, though the chosen specification does affect the quantitative results.

[9] Such spillovers are often associated with capital inputs (Romer, 1986), with equipment investment (De Long and Summers, 1991) or with R&D investment (Griliches, 1992). Whether or not there are significant externalities associated with capital, or with particular types of capital, remains an empirically unsettled issue (Crafts, 1996; Oulton and Young, 1996). I therefore link the externality to aggregate output, where the evidence to date appears clearer.

[10] 'Labour' inputs then have to be interpreted as 'basic' labour.

Aggregating over firms, and assuming 100% depreciation per period,[11] competitive conditions equate the interest rate $r(t)$ and wage rate $w(t)$ to (private) marginal products:[12]

$$r(t) = ak(t)^{a(1+e)-1} - 1,\ R(t) = 1 + r(t), \tag{6a}$$

$$w(t) = (1-a)A(t)[A(t)\mathrm{L}(t)]^{e/[1-a(1+e)]}k(t)^{a(1+e)}, \tag{6b}$$

$$k(t) = K(t)/X(t), \tag{6c}$$

$$X(t) = [A(t)L(t)]^{[(1-a)(1+e)]/[1-a(1+e)]}. \tag{6d}$$

Defining $y(t) = Y(t)/X(t)$, $y = k^{a(1+e)}$, and in steady state y, k, and therefore, from (6a), r are all constant, whilst w grows at the following steady rate per period:[13]

$$w(t) = (J/N)w(t-1),\ J = (NG)^{[(1-a)(1+e)]/[1-a(1+e)]}. \tag{6e}$$

2.2. *Consumers*

Feldstein assumes that a proportion H of the population consists of forward-looking life cycle maximisers ('life cyclers') and the remaining $(1-H)$ are 'myopes' who never save anything.[14] All individuals are otherwise identical. Each lives for either one or two periods and supplies labour inelastically in the first period only. Those who are young at time t receive wage income $w(t)$, which is taxed at rate q to provide pensions for the currently old. Feldstein assumes that all individuals live for both periods, but for greater generality I assume that each individual has an *ex ante* survival probability of π, $0<\pi<1$, so that with population growing at rate $(N-1)$ per period, the ratio of currently young to currently old consumers is N/π; hence *per capita* tax

[11] Subsequently each 'period' is defined as 30 years, so that with conventional annual depreciation rates, 100% depreciation is a reasonable approximation as well as a convenient simplification.

[12] $K(t)$ denotes aggregate capital.

[13] Taking a continuous time version of the aggregate version of (5), differentiating and writing g_I for the instantaneous proportionate growth rate of $I(I = Y, K, A, L)$:

$$g_Y = (1+e)[ag_K + (1-a)(g_A + g_L)]. \tag{i}$$

Since both g_A and g_L are exogenously constant, g_Y is constant if g_K is constant; the latter is thus the required condition for a steady state growth path. In steady state saving is a constant proportion of output (cf. (9a)). Writing S for this proportion:

$$g_K = (SY/K) - \text{depreciation rate}.$$

Hence g_K is constant if Y/K is constant and so if $g_Y = g_K$. Substituting the latter into (i) above and rearranging, steady state growth is:

$$g_Y^* = g_K^* = \left[\frac{(1+e)(1-a)}{1-a(1+e)}\right](g_A + g_L). \tag{ii}$$

Substituting (ii) into (6) indicates that k, and therefore y and r, are constant in steady state. The steady state growth of real wages is, from (6b):

$$g_w^* = g_A + \left[\frac{e}{1-a(1+e)}\right](g_A + g_L) = \left[\frac{(1+e)(1-a)}{1-a(1+e)}\right](g_A + g_L) - g_L.$$

[14] I have altered Feldstein's notation.

payments of $qw(t)$ yield *per capita* PAYG pensions of $qNw(t)/\pi$. Myopes set consumption equal to after-tax wage income and pension income respectively in their young and old periods. Life cyclers who are young at time t have the following objective function:

$$V(t) = \ln c_1(t) + (\pi/D)\ln c_2(t+1). \tag{7}$$

$c_1(t)$ and $c_2(t)$ denote consumption at time t of those who are young and old respectively at t. $D \geqslant 1$ is the time preference factor (Feldstein assumes $D = 1$). Equation (7) is maximised by choosing discretionary saving $s(t)$ subject to the budget constraints:

$$c_1(t) = (1-q)w(t) - s(t), \tag{8a}$$

$$c_2(t+1) = R(t+1)s(t)/\pi + qNw(t+1)/\pi = R(t+1)s(t)/\pi + qJw(t)/\pi. \tag{8b}$$

The first part of the middle expression in (8*b*) is discretionary saving; the second part is the PAYG pension. Substituting for $w(t+1)$ using (6*e*) gives the final expression in (8*b*). (8*b*) assumes that actuarially fair retirement annuities are available, with gross returns R/π. Since there is no bequest motive, all discretionary saving is in this form. This avoids 'accidental' bequests, which complicate the wealth distribution and so prevent a representative agent analysis (Abel, 1985). Such complications are tangential to the analysis, and it seems legitimate to avoid them. Pecchenino and Pollard (1997) do so by assuming that accidental bequests are shared equally among all next-generation consumers. As already noted, Feldstein (1985) does so by assuming $\pi = 1$.

Maximising (7) subject to (8) yields optimal saving and consumption:

$$s(t) = \frac{[\pi R(t+1)(1-q) - qDJ]w(t)}{R(t+1)(\pi + D)}, \tag{9a}$$

$$c_1(t) = \left(\frac{D}{D+\pi}\right)\left[1 - q + \frac{qJ}{R(t+1)}\right]w(t),\ c_2(t+1) = \left[\frac{R(t+1)}{D}\right]c_1(t). \tag{9b}$$

Equation (9) indicates the distorting effects of the PAYG tax q: for given w and R, saving is unambiguously reduced, as is consumption provided that $R > J$, i.e. provided that the economy is dynamically efficient, which Abel *et al.* (1989) argue has been the case in the United States and other industrial economies at least since the 1920s.[15]

2.3. *The Steady State Solution*

Noting that only life-cyclers – proportion H of the population – save, capital evolves as follows:

$$K(t+1) + F(t+1) = HL(t)s(t). \tag{10}$$

[15] Using (6*e*), if $e = 0$ (no production externalities) the dynamic efficiency condition is the familiar requirement $R > NG$. If $e > 0$ the condition looks less familiar, but the expression for R derived in (11) below indicates that dynamic efficiency is in fact independent of e.

K is the domestic country capital stock and F denotes net foreign asset holdings by domestic residents. Out of steady state, F can be positive or negative for any one country. Here I analyse only steady states,[16] whence since all countries are identical, all have $F = 0$. Define R^* as the equilibrium (gross) world interest rate, which generates a steady state capital intensity k^* in (10). Combining (6a), (9) and (10):

$$R^* = \frac{J[a(D+\pi) + qDH(1-a)]}{H\pi(1-a)(1-q)}. \tag{11}$$

Steady state values for other variables can then be derived by appropriate substitution:

$$k^* = (a/R^*)^{1/[1-a(1+e)]}, \tag{12a}$$

$$w(t)^* = (1-a)[X(t)/L(t)](k^*)^{a(1+e)}, \tag{12b}$$

$$c_1(t)^* = \left(\frac{D}{D+\pi}\right)\left(1-q+\frac{qJ}{R^*}\right)w(t)^*, \; c_2(t)^* = \left(\frac{R^*}{D}\right)c_1(t-1)^*. \tag{12c}$$

2.4. *National and Global Optimisation*

Following Feldstein (1985) steady state social welfare $W(t)$ is a weighted average of the current period steady state utility of currently young and old life-cyclers and myopes:

$$W(t) = H[N\ln c_1(t)^* + \pi\ln c_2(t)^*] + (1-H)\{N\ln[(1-q)w(t)^*] + \pi\ln[qNw(t)^*/\pi]\}. \tag{13}$$

The choice variable is the tax rate q, which affects welfare both directly, and indirectly via its impact on world saving and thus on capital intensity, wages and interest rates. When each national government acts independently, however, the indirect effects are ignored because the impact of its choice on world saving is negligible; hence to a first approximation, wages and interest rates are taken as given and only the direct tax effects are considered. The Appendix, part A.1, derives the first order condition, from which the nationally optimal tax rate is:

$$q^* = [S_1 + (S_1^2 - 4S_0S_2)^{0.5}]/2S_0, \tag{14a}$$

$$S_0 = H(N+\pi)(D+\pi)(1-a), \tag{14b}$$

$$S_1 = \pi H(1-a)[D+\pi+H(N-D)] - a(N+\pi)(D+\pi), \tag{14c}$$

$$S_2 = -a\pi(1-H)(D+\pi). \tag{14d}$$

Substituting (14) into (11)–(13) then gives steady state outcomes conditional on separate national optimisation in each individual economy. If instead social security policy is co-ordinated internationally, the choice of q can take account

[16] Pemberton (1998a,b) develops a dynamic analysis of the transition between policy regimes in a single economy and a world economy context.

of the impact on world saving and its consequences. The Appendix, part A.2, describes the numerical solution for the resulting global optimum tax rate q^{**}.

2.5. *Comparison of National and Global Outcomes*

Writing $W(t)^{**}$ and $W(t)^{*}$ for steady state national welfare with and without policy co-ordination, and noting that $W(t)^{**} > W(t)^{*}$, define $\hat{A}(t)$ as the notional level of total factor productivity (TFP) which, if it replaced the actual level $A(t)$ in $W(t)^{*}$, would raise the latter to equality with $W(t)^{**}$. Then define:

$$\Delta A = 100[\hat{A}(t) - \mathrm{A}(t)]/A(t). \tag{15}$$

ΔA measures the percentage increase in TFP which, if it were to occur in a context of uncoordinated policies, would raise steady state national welfare by an amount equal to the gain from switching to internationally co-ordinated policies.

3. Calibration and results

3.1. *Calibration*

Values need to be assigned to a, e, N, G, π, D, and H. Barro *et al.* (1995, pp. 107–8) take $a = 0.3$ as the base value in a 'narrow' capital context, and $a = 0.8$ in a 'broad' context (i.e. including human as well as physical capital). Oulton and Young (1996, p. 53) suggest a higher value in the narrow capital context: they calculate the average share of business capital in income across the OECD as 37.5% in 1994, and if capital's share is measured as one minus the share of employee compensation, the OECD average is 47%. Partly on this basis Oulton (1996*b*) takes $a = 0.4$ as the base value. Conversely, for reasons discussed later, a referee suggested a value below 0.3. I consider values of 0.25, 0.33, and 0.4; I also briefly note the implications of a 'broad' capital interpretation with $a = 0.8$. For population growth and technical progress Barro *et al.* (1995, p. 107), take annual rates of 1 and 2% respectively, reflecting long run US trends. Interpreting a 'period' – a generation span – as 30 years gives $N = 1.01^{30} = 1.35$, and $G = 1.02^{30} = 1.81$. I adopt the same base values. Experience differs somewhat among countries. For example, technical progress in recent decades has been faster than in the United States in Germany and Japan, and a little slower in the United Kingdom (Blanchard, 1997, p. 448). Growth in the population of working age has been somewhat higher in the United States than in most other industrial economies, and the same applies to growth in actual employment (Elliott, 1991, pp. 16–9). (In the paper N stands interchangeably for both population and employment growth.) I allow for such variations by considering a range of values of N and G, though it turns out that most of the paper's results are unaffected by the choice of G. The annual time preference rate is conventionally assumed to be in the range 1–5 %; I take 3% as the base value, whence $D = 1.03^{30} = 2.43$.

The choice of numerical value for π is motivated by noting that π/N is the aged dependency ratio (M). M can be measured in more than one way: (i) as the ratio of the total population aged over 65 to the total population of working age; or (ii) as the ratio of the total number in receipt of a state pension to the total of current contributors to the pension scheme. The latter measure, which determines the contribution rate required to finance any given pension level, is used in the present paper. On this basis the current value of M in the United Kingdom is 0.43 and its projected value in 2025 is 0.63 (Blake, 1992, pp. 35–6). The current value in the United States is 0.29 and the projected value in 2070 is 0.56 (Gramlich, 1996, p. 359). Comparably large increases are projected for other large industrialised countries (Fabel, 1994, p. 8). Both present and projected future circumstances are of interest. I therefore take a base value for M of 0.35, reflecting current circumstances, but also consider values up to 0.65, reflecting future projections. The implied value for π thus ranges from $0.35N$ to $0.65N$.

Turning to the knowledge spillover parameter, e, Oulton (1996*a*) estimates four variants of a model whose production structure resembles (6). All are consistent with approximately constant internal returns; the estimates give implied values of e between 0.10 and 0.24 (mean value 0.18). Caballero and Lyons (1990, 1992) generally find decreasing internal returns but bigger implied estimates of e, e.g. for the United States manufacturing, a mean estimate of 0.41 (1992, Table 2, p. 215) though when they correct the United States estimates for changes in aggregate effort, they then generate results very similar to Oulton's (Caballero and Lyons, 1992, Table 3, p. 217 indicates approximately constant internal returns and average $e = 0.20$). I consider values of $e = 0$, 0.2, and 0.4, with $e = 0.2$ as the base value.

The remaining parameter, H, defines the proportion of forward-looking consumers in the population. If $H < 1$ there are some myopes. There is clear evidence that a significant fraction of the population breaks even (Campbell and Mankiw, 1989, 1991) and has zero liquid assets (Carroll, 1994, p. 132; Radner, 1989, pp. 676–7). This of course does not prove myopia: some consumers may rationally save nothing, relying on social security to cover low-income contingencies (Hubbard *et al.*, 1995). Historical evidence is worth noting in this context. In nineteenth century Britain, despite the absence of state pensions, few working class households made any retirement provision (Hannah, 1986, ch. 1), and thus risked ending their lives in the workhouse, a prospect widely viewed with horror in Victorian Britain (Bruce, 1968, ch. 4), as readers of Charles Dickens (especially the early chapters of *Oliver Twist*, and parts of *Our Mutual Friend*) will be well aware. Despite this, contemporary poverty research chronicled that two-thirds of those on low life time income who survived into old age had recourse to the poor law provision (Treble, 1970, p. 268, fn. 2). While the probability of survival to old age was lower than now, it was not negligible. In 1851–5, for those reaching age 20 in England and Wales the average probability of living to age 65 was 0.47.[17] Life expec-

[17] Males and females combined, using life tables in *Mortality Statistics 1841–1990* (Office of Population Censuses and Surveys), Table 2, page 3.

tancy was below average for poorer people, but set against this was a significant probability of disabling illness or work injuries, and consequent risk of recourse to the poor law, before age 65 (Hannah, 1986, ch. 1). Hence poorer non-savers faced a significant risk of ending their days in the workhouse. That non-saving was widespread despite this is not easily reconciled with the view that no-one is truly myopic.

Overall, there seems enough evidence to justify the assumption that the population contains a fraction of myopes, but its size is less clear. Feldstein (1985) considers fractions between 0.25 and 0.75. In the rest of the paper I consider the cases $H = 0.9$ (i.e. 10% myopes) and $H = 0.75$ (25% myopes).

3.2. *Results*

Table 1 presents detailed results. In all cases I report the optimal tax rate q^* and the resulting annual world interest rate r^* when each country chooses its policy independently; the globally optimal tax rate q^{**}; and the percentage increase ΔA in TFP which would generate an increase in social welfare equal to that obtained by switching from q^* to q^{**}. All entries are in percentage terms. The values of both r^* and q^* are derived endogenously; the results can

Table 1

Gains from International Co-ordination of National Social Security Policies

Parameter		$H = 0.75$				$H = 0.9$			
		q^*	r^*	q^{**}	ΔA	q^*	r^*	q^{**}	ΔA
$a = 0.25$	$e = 0$	8.43	7.37	5.62	0.68	4.03	6.34	2.68	0.27
	0.2	8.43	8.28	4.62	1.56	4.03	7.24	2.06	0.78
	0.4	8.43	9.35	3.82	2.87	4.03	8.30	1.62	1.55
$a = 0.33$,	$e = 0$	7.78	8.56	4.37	1.41	3.47	7.58	1.87	0.64
	0.2	7.78	9.63	3.52	2.86	3.47	8.65	1.45	1.39
	0.4	7.78	10.99	2.83	5.05	3.47	9.99	1.13	2.53
$a = 0.4$,	$e = 0$	7.42	9.54	3.68	2.18	3.20	8.60	1.51	0.98
	0.2	7.42	10.81	2.88	4.34	3.20	9.85	1.15	2.03
	0.4	7.42	12.55	2.22	7.89	3.20	11.58	0.86	3.72
$a = 0.33$,	$e = 0.2$								
$M =$	0.175	4.12	11.59	1.71	2.00	1.73	10.72	0.67	0.97
	0.5	10.60	8.78	5.11	3.16	4.97	7.72	2.21	1.54
	0.65	13.18	8.23	6.69	3.28	6.46	7.12	3.04	1.58
$D =$	1.01^{30}	8.78	7.98	3.85	3.20	4.29	7.02	1.65	1.76
	1.05^{30}	7.22	11.46	3.33	2.67	3.06	10.46	1.34	1.22
$G =$	1.01^{30}	7.78	8.21	3.52	2.86	3.47	7.23	1.45	1.39
	1.03^{30}	7.78	11.07	3.52	2.86	3.47	10.07	1.45	1.39
$N =$	1	7.44	9.10	3.41	2.74	3.22	8.12	1.38	1.29
	1.02^{30}	8.21	10.20	3.67	3.00	3.80	9.22	1.53	1.54

Note: M, N, D and G are at base values ($M = 0.35$, $N = 1.35$, $D = 2.43$, $G = 1.81$) except as indicated in the left hand column.

be used as a partial check on the underlying plausibility of the parameterisations. Looking first at q^*, note that q^* divided by the aged dependency ratio (M) gives the pension as a fraction of the current wage. Hence in the top row of Table 1 the pension is 24.1% of the current wage when $H = 0.75$ and 11.5% when $H = 0.9$;[18] and similarly for other rows. These figures can be compared with the basic state pension in the United Kingdom, whose value is around 15% of average earnings.[19] Values of H in the 0.75–0.9 range (and base values for other parameters) thus generate 'reasonable' values for q^* in the UK context, though as a referee noted, the UK pension replacement rate is well below that in the United States and in many European Union countries (Blake, 1992, p. 101).

Turning to r, Feldstein (1985, p. 313) sets $r = 11.4\%$, the average annual marginal product of capital in the United States non-financial corporations 1950–80; Feldstein (1996, p. 3) refers to an annual rate of 9.3% on non-financial capital 1960–95. Scott (1989, Table 7.3, p. 207) reports a corresponding rate of 8.9% for the United Kingdom over 1951–73. On this basis, values for r^* in the range 8–11% are desirable if the model is to approximate observed outcomes over the past 50 years. On the other hand, a referee argued that the appropriate comparison is with the average rate of return on the overall personal wealth portfolio, which includes not only equity (backed by physical capital) but also housing and fixed income securities. These latter assets lower the overall rate of return below my suggested lower limit of 8%, and some authors have adopted lower values: e.g. Barro *et al.* (1995) impose a target value of $r = 6\%$. The top half of Table 1 indicates that r^* is increasing in a and in e, and this provides a basis for the referee's suggestion, mentioned earlier, that a value for a around 0.25 would be appropriate, since this more easily generates values for r^* in the 6–8% range. It should however be noted that the present paper's model does not incorporate housing or government debt: its 'capital' consists only of output-producing assets, whose marginal product determines r^*; hence internal consistency within the paper provides a counter-argument for focusing on values for a of one third or more, which can more easily generate values of r^* in the 8–11% range. Given that the appropriate value, or range of values, for r^* is debatable, I therefore consider a range of values for the technology parameters a and e in the top part of Table 1.

As noted earlier, ΔA in Table 1 measures the gains from policy co-ordination. These range from 0.27% to 7.89% of national income. At the base value $e = 0.2$ for the spillover parameter and the intermediate value $a = 0.33$ for the capital share the gains range from 1.4% when $H = 0.9$ to 2.9% when $H = 0.75$. To put these results in some perspective, Lucas (1987) estimates that the welfare gains from the elimination of all cyclical fluctuations in the United States economy

[18] This row uses the base value $M = 0.35$ for the dependency ratio

[19] The UK's SERPS is also a PAYG scheme, but is not comparable with the pension modelled in the present paper, because it is not universal. Pemberton (1997*b*) examines non-universal schemes within the Feldstein framework.

would be less than 1/10 of 1% of average consumption. Even the lowest gains estimates in Table 1 are well above Lucas's figure. Another interesting comparison is with the welfare gains from reduced inflation. The most recent study of this, by Chadha *et al.* (1998) estimates an optimal nominal interest rate for the United Kingdom of around 2%, and estimates a net welfare gain from moving from 6% to 2% of around 0.22% of GNP (Chadha *et al.*, 1998, p. 381). Again, this is smaller than the lowest welfare gain in Table 1.[20] Hence the potential gains from social security co-ordination are very far from trivial by comparison with other important economic policy objectives.

As already noted, all the values of a considered reflect a 'narrow' interpretation of capital, whereas a 'broad' interpretation – incorporating human as well as physical capital – would justify higher values, perhaps around 0.8. Table 1 indicates that the gains from policy co-ordination are increasing in a. Experimenting with $a = 0.8$ indicated dramatically large gains. The difficulty is that, as already discussed, r^* is also increasing in a, and at $a = 0.8$ r^* takes values well above the 8–11% range suggested earlier, and indeed well above any remotely defensible value, for all plausible values of the remaining parameters. Such findings suggest that the 'broad' interpretation of capital may contain some as yet unexplored problems.[21] For this reason Table 1 does not report results for this case.

The bottom half of Table 1 sets the technology parameters at my preferred value $e = 0.2$ for the externality parameter and at the intermediate value $a = 0.33$ for the share of capital, and considers other parameter variations. Perhaps the most interesting results concern the effect of changes in the aged dependency ratio, M. Comparing the top and bottom halves of Table 1 indicates that the welfare gains from co-ordination do not vary much over the relevant range of present and projected future values for M. Thus a near-doubling of M, from 0.35 to 0.65, increases co-ordination gains by only 14–15% for values of $H = 0.75$ or $H = 0.9$. Conversely, if M could (implausibly) be cut in half in future – e.g. by raising the age of eligibility for retirement pensions – there would be a somewhat larger fall, of around 30%, in co-ordination gains, but the latter would still remain significant. The lower part of the Table also briefly notes results for other parameters. It indicates that co-ordination gains are unaffected by G, and vary only a little over the plausible range of values for N and D.

3.3. *Can Co-ordination be Pareto Improving?*

Welfare gains in Table 1 are measured in relation to (13), which is a weighted average of life cyclers' and myopes' utility. Since the former are always better

[20] It should be noted that considerably larger welfare gains from lower inflation are estimated by Lucas (1995), quoted by Chadha *et al.* (1998). Chadha *et al.* provide a number of reasons for believing that Lucas's estimates are considerably too high at around 1% of GNP. Even if Lucas's estimate were accurate, however, it would still be comparable with, or smaller than, most of Table 1's entries.

[21] Barro *et al.* (1995) do not consider this point; as already noted, they impose, rather than derive, a value of $r = 6\%$.

off than the latter in terms of life time utility,[22] and since policy co-ordination always involves $q^{**} < q^{*}$, co-ordination is unambiguously inegalitarian in its effects, and life cyclers unambiguously gain. Myopes can either gain or lose in absolute terms: they obtain a smaller share of an increased national income. If they gain, co-ordination is then Pareto improving. With the utilitarian objective function (13), no particular significance is attached to Pareto improvements, but in practice this might be an issue: e.g. national governments might veto the loss of national sovereignty unless it were Pareto improving. In this case the conditions under which myopes, as well as life cyclers, gain from co-ordination are important. In Table 1 myopes are worse off (in terms of steady state life time utility) at the co-ordinated (q^{**}) than at the uncoordinated (q^{*}) tax rate in every case except one ($H = 0.75$, $D = 1.05^{30}$). However, this overstates the extent to which co-ordination necessarily hurts myopes, since in a much larger proportion of Table 1's entries there is some intermediate tax rate q_m^{**}, $q^{**} < q_m^{**} < q^{*}$, such that myopes gain from co-ordination (and co-ordination is therefore Pareto improving) provided that it does not lower the tax rate beyond q_m^{**}. The necessary and sufficient condition for this is $dV_m^{*}(t)/dq < 0$ evaluated at $q = q^{*}$, where $V_m^{*}(t)$ is steady state myopic life time utility (cf. (7)), and where the total derivative d/dq incorporates the indirect tax effects (on capital intensity and therefore the wage rate) as well as their direct impact. The Appendix, (A.4), formulates the Pareto improving condition. The latter can be illustrated for technology parameters $a = 0.33$, $e = 0.2$. With other parameters at base values, (A.4) holds for $H < 0.787$, i.e. if myopes constitute more than 21.3% of the population. The critical value of H, call it H^{*}, below which (A.4) holds, varies positively with a and with e, though the relationship is not very strong: e.g. for $e = 0.2$ $H^{*} = 0.775$ when $a = 0.25$ and 0.805 when $a = 0.4$; at $a = 0.33$ $H^{*} = 0.737$ when $e = 0$ and 0.829 when $e = 0.4$. Hence within the defensible range of values of technology parameters, co-ordination can be Pareto improving provided that around 17–26% or more of the population are myopes. Such proportions may seem very high from the perspective of economic models with forward-looking consumers, but the earlier brief review of evidence suggests the possibility that a significant proportion of consumers is not forward-looking at all. For example, Campbell and Mankiw (1991, Table 2, p. 736) estimate the fraction of national income going to individuals who consume their current rather than their permanent income. If this is interpreted as measuring the proportion of myopes (though this is obviously not the only possible interpretation) then for the United States the estimated proportion is 36.3% – large enough to generate absolute gains for myopes for a wide range of defensible technology parameter values – and for other major Western economies it ranges between 20% and nearly 100%.

[22] This is true for the representative life cycler provided that, starting from zero saving, her life time welfare increases with an increase in saving. If this condition were not satisfied, life cyclers would choose to behave like myopes. The condition is satisfied for all parameterisations in the paper, as is essential (since if life cyclers do not save no national wealth is accumulated).

4. Conclusion

Social security policies are determined on a national basis, but this is inefficient in the sense that international co-ordination of policies would raise steady state national welfare in all countries. The wedge between inefficient national and efficient global optimisation is always in the same direction in a steady state context: national policies over-expand social security. This is because each nation's policies create negative global externalities via induced rises in world interest rates. A detailed illustrative example suggests that the gains from international co-ordination are far from trivial: they are substantially larger, for example, than estimates of the gain from other frequently-advocated macro policy changes.

The paper has simplified the issues in many ways. For example, consumers face no income uncertainty, face perfect capital markets,[23] have no intergenerational altruism, and live two-period rather than multi-period lives. The world economy has many identical small economies rather than a mixture of large and small countries, some with positive and others with negative net foreign assets. The paper considers only steady state effects and ignores transitional dynamics.[24] It would be useful to expand the analysis to incorporate these and other complications.

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Appendix: Optimal Choices and Pareto Improvements

A.1. *National Optimisation*

Substituting (12) into (13) and rearranging allows the social welfare function $W(t)$ to be rewritten:

$$W(t) = H(N+\pi)\ln(1-q+qJ/R^*) + (1-H)[N\ln(1-q)+\pi\ln q] + (N+\pi)\ln w(t)^* + H\pi\ln R^* + \text{constant terms.} \tag{A.1}$$

The national choice of q exerts a direct effect on national welfare via the first two R.H.S. terms; the aggregate world effect of each country's separate national choice also exerts indirect effects via w^* and R^* in the first, third and fourth terms. In the national context only the direct effects are taken into account, whence the first order condition is:

$$\frac{\partial W(t)}{\partial q} = (1-H)\left(\frac{\pi}{q} - \frac{N}{1-q}\right) - \frac{H(N+\pi)(R^*-J)}{R^*(1-q)+qJ} = 0. \tag{A.2}$$

Substituting for R^* from (11) and rearranging gives (14).

[23] Pemberton (1997) and Casarico (1998) suggest that this may be an important simplification.
[24] Pemberton (1998*a*, *b*) considers transitions between policy regimes.

A.2. *Global Optimisation*

With global optimisation the choice of q reflects all direct and indirect effects in (A.1) and thus satisfies $dW(t)/dq = 0$. The latter condition involves the two R.H.S. terms in (A.2), plus the impact of q on R^* in the first and fourth terms of (A.1), and on w^* in the third term. The result is a cubic equation in q which cannot be solved analytically. Simulations of $W(t)$ indicated that for all parameter values considered there is a single value q^{**} in the admissible range $0 < q^{**} < 1$ such that $dW(t)/dq = 0$ at $q = q^{**}$, $dW(t)/dq > 0$ for $0 < q < q^{**}$, and $dW(t)/dq < 0$ for $q^{**} < q < 1$. I therefore solved (A.1) numerically to find q^{**} using *Mathematica* (Wolfram, 1991), which was also used to generate all the paper's other results.

A.3. *Pareto Improvements*

Using (7) and (8), myopic life time utility is:

$$V_m(t) = \ln(1 - q) + \frac{\pi}{D}\ln q + \left(\frac{\pi + D}{D}\right)\ln w(t) + \text{constant terms.} \tag{A.3}$$

For international policy co-ordination to be capable of generating a Pareto improvement requires $dV_m(t)/dq < 0$ when evaluated at $q = q^*$: i.e. a marginal world-wide reduction in q yields a net gain in myopic utility. Differentiating (A.3) at $q = q^*$ gives the required condition:

$$\frac{\pi}{Dq^*} - \frac{1}{1 - q^*} + \left[\frac{\pi + D}{Dw(t)^*}\right]\frac{dw(t)^*}{dq} < 0. \tag{A.4}$$

Since $dw^*/dq < 0$, (A.4) can hold if the indirect tax effects are sufficiently strong.

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