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BORROW AND ADJUST: FISCAL POLICY AND SECTORAL ADJUSTMENT IN AN OPEN ECONOMY

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Abstract

Should the government run fiscal deficits in response to an adverse external shock that warrants transfer of resources from production of non-traded to traded goods? This paper considers normative fiscal policy implications of sectoral adjustment costs in a two-sector model with overlapping generations. Fiscal deficits benefit present generations by depleting foreign assets and slowing down the adjustment process. We show that despite no nominal rigidities, temporary fiscal deficits increase social welfare if adjustment costs prevent immediate sectoral reallocation of inputs. If there are no adjustment costs, the case for fiscal deficits vanishes.

JEL Classification: F41, E62, H62.

Keywords: fiscal policy, sectoral adjustment, intergenerational welfare.

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1. INTRODUCTION

In today's integrated world economy, access to world markets is crucial for almost any country's economic prosperity. Nevertheless, many small open economies occasionally experience painful losses of national income and wealth triggered by adverse external trade shocks. Developing countries that are heavily dependent on primary exports seem to be particularly vulnerable to such setbacks (Collier and Gunning, 1999). Examples can also be found, however, among newly industrialized countries and OECD countries.

A particularly dramatic example of the latter is the recent economic crises in three of the Nordic welfare states, Norway, Sweden and Finland. In these countries, long periods of rapid economic growth were abruptly reversed after adverse external shocks hit in the late 1980s. The ensuing losses of national income also had profound negative effects on the balance of payments and government budgets. The governments were taken by surprise by these developments. The crises were not merely perceived as temporary aggregate demand setbacks that could justify fiscal policy stimuli to smooth consumption. The economic policy challenges were much more difficult because the national income losses had rendered the previous consumption and government spending levels unsustainable. Sooner or later, fiscal austerity therefore seemed inevitable. This also had implications for economic structure: The inherited size of the sector producing non-traded goods appeared to be excessive, and it was evident that structural change was necessary to prevent excessive accumulation of foreign debt.

To address these issues, the present paper offers a normative analysis of the following problem: How should fiscal policy respond to an adverse trade shock that reduces national wealth and warrants sectoral reallocation of domestic inputs from the production of non-traded goods to tradables? Surprisingly, this normative problem has not received much attention in the literature.[1] As our analytical framework, we chose a dynamic dependent economy model. There are three sectors, which produce labor-intensive non-traded goods, an exportable resource good, and other (capital

[1] Most papers that look at optimal dynamic adjustment to permanent shocks assume Ricardian equivalence, see for example Gavin (1990,1992), Steigum (1992) and Morshed and Turnovsky (2000). Papers that do depart from Ricardian equivalence tend to restrict their attention to positive analysis of fiscal policy, see for example Buiter

intensive) tradables, respectively. The resource sector is the "crisis sector" that is hit by an external shock that reduces national wealth. Due to fixed capital in the sector producing other tradables, the adverse external shock also generates positive wealth effects that could be important for intergenerational distribution.[2] Adopting the uncertain lifetimes approach of Blanchard (1985), we can address these generational policy issues. This framework, which involves a departure from Ricardian equivalence, has proven useful in addressing a number of positive fiscal policy issues in the recent literature on international macroeconomics. A novelty of the present paper is that we use a utilitarian welfare function to derive the optimal policy.

The optimal choice of fiscal policy strategy must clearly depend on the extent to which the *government itself* loses revenues from the adverse shock. For example, in many oil-exporting countries, the government receives most of the oil revenues. Moreover, even if the government has no stake in the sectors hit by the trade shocks, its budget is likely to be negatively affected due to the tax-transfer system, such as in the Nordic welfare states. This issue is usually kept in the background in models that assume a representative consumer.

If all domestic inputs are fully mobile in the short run, the adjustment to a persistent shock could be done quickly. Expanding an internationally competitive sector is often a costly and time-consuming process, however, particularly if this requires access to specialized physical and human capital that are not immediately available. Models that permit jumps in the industrial structure are therefore not very attractive for the questions that we address. We therefore introduce sectoral adjustment costs that generate a gradual process of optimal reallocation. As a stand-in for various adjustment costs, we assume that the expansion of the sector producing tradables is gradual due to training costs.[3] For simplicity, labor is the only input that is mobile, while capital is sector-specific. It

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(1987), Macklem (1993) and van der Ploeg (1996).

[2]This wealth effect is positive because the product wage falls and profits go up.

[3] Training costs and other adjustment costs in the labor market play a central role in models explaining labor market dynamics, see for example Davis and Haltiwanger (1999). Steigum (1984) has explored implications of training costs for the speed of sectoral change in open economies. Matsuyama (1992) studies sectoral adjustment of labor when old workers are irreversibly tied to the sector they once entered, but new workers are attracted to the high productivity sectors. In the recent literature on transition problems in countries shifting to trade liberalization, costs of labor market adjustment are often considered to be crucial, see for example Aghion and Blanchard (1994), Atkeson and Kehoe (1996) and Karp and Paul (1994). In the real business cycle literature, it has been argued that slow sectoral adjustment of labor is necessary to explain the cross-sectoral movement of output and labor inputs in the data, see for example Murphy, Shleifer and Vishny (1989), Loungani and

turns out that the existence of adjustment costs is important for the nature of optimal fiscal policy. In our model framework, the choice of fiscal policy strategy affects the speed of structural change and the accumulation of foreign debt, and thus triggers intergenerational distribution effects. Fundamentally, this problem is non-monetary, involving wealth effects, dynamic resource allocation, and changes in the relative price of non-traded goods over time. To focus our attention on fundamentals, we abstract from «Keynesian» features such as nominal rigidities and financial fragility.[4]

Our paper attempts to bridge the gap between two strands of analysis. The first is the literature on dynamic trade theory, initiated by Mussa (1978) and Neary (1978), which emphasized that some factors of production - physical capital in particular - are sector-specific in the short run, excluding immediate sectoral reallocations of these inputs. Adopting a representative consumer/intertemporal optimization approach, more recent contributions to this literature -- such as Murphy (1988), Gavin (1990, 1992) and Morshed and Turnovsky (2000) -- have examined optimal dynamic responses to permanent shocks. All these papers assume that labor is homogenous and can move instantly between sectors. Different ways of modeling gradual sectoral adjustment of capital have been explored. Some papers, such as Neary (1978) and Murphy (1988), assumed that installed capital is permanently sector-specific. Therefore, their models only permit slow changes in the sectoral allocation of capital through new investment and depreciation of old capital. Other papers, such as Mussa (1978) and Gavin (1990, 1992), introduce a third "retrofit" sector that uses labor to transform old capital from one sector into productive capital for another. A recent paper by Morshed and Turnovsky (2000) considers capital accumulation as well as sectoral movements of capital that are subject to quadratic adjustment costs.[5]

The second strand of analysis mentioned above has focussed on wealth and asset accumulation effects of fiscal policy in open economy models in which different cohorts of consumers are not linked through operative gift and bequest motives. Building on Blanchard's (1985) uncertain

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Rogerson (1989) and Greenwood, MacDonald and Zhang (1996). However, Huffman and Wynne (1999) argue that for business cycle analysis, immobility in labor may not be as important as immobility in capital.

[4] Hence, our model does not capture monetary aspects of the propagation of external shocks, for example related to inappropriate exchange rate policy and currency crisis.

[5] Still another possibility is intrasectoral adjustment costs, see Huffman and Wynne (1999). Such costs make it difficult to alter the composition of production of new capital goods. They show that the introduction of intrasectoral adjustment costs in a multisector real business cycle model helps to reproduce the procyclical

lifetimes approach, Frenkel and Razin (1986), Buiter (1987) and Obstfeld (1989) have studied international spill-over effects of government debt policy. International linkages are beyond the scope of the present paper, however, which focuses on one single economy and gradual sectoral adjustment.

Our paper is related to, and draws on Buiter (1988), Mansoorian (1991) and Macklem (1993).[6] Buiter (1988) analyzed the effects of various fiscal policy experiments in a model with non-traded goods, but he abstracted from sectoral adjustment costs and wealth effects from fixed factors of production. Mansoorian's (1991) model allows jumps in the industrial structure as well, and his model also includes wealth effects from two fixed factors. He did not focus on fiscal policy, however, but investigated the dynamic implications of a private resource discovery that permits the current wealth owners to increase their welfare at the expense of future generations. Macklem (1993) developed a two-sector model calibrated to the Canadian economy. Sectoral adjustment occurs gradually because both the non-traded and the traded goods sectors accumulate imported capital goods subject to quadratic costs of adjustment. He derived effects of a permanent terms-of-trade disturbance that are similar to the effects of a private wealth shock in our model. Also his analysis of an unanticipated increase in government debt, which involves a corresponding drop in national wealth, yields similar results as in our model.[7]

We find that the normative implications for fiscal policy are sensitive to the existence of sectoral adjustment costs. If the economy is hit by a permanent shock that reduces national wealth, the social planner should run temporary fiscal deficits.[8] The case for fiscal deficits vanishes, however, if domestic factors of production are fully mobile. To see the economic intuition behind this result, suppose the government keeps the budget balanced after an adverse shock. This policy will generate an intertemporal equilibrium involving real exchange rate overshooting, followed by a gradual real depreciation. Hence, the real rate of interest on non-traded goods is low during the process of transferring resources to traded goods production. A social planner could therefore increase welfare by

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behavior of cross-sector measures of capital, employment and output observed in U.S. data.

[6] Another early paper in this literature is Giovannini (1988). His focus on the long-run effects of fiscal policy on the capital stock and the real exchange rate is however different from ours.

[7] This suggests that our assumption that the adjustment cost is associated with the *labor* input is not crucial for these experiments. We return to this question in Section 4.4.

[8] The optimal policy also involves a wealth tax or wealth subsidy at the time of the shock, but this is necessary in the case of zero adjustment costs too.

running temporary fiscal deficits, increasing the welfare of the present generations. Intuitively, present generations are benefiting from the initial excessive size of the non-traded sector, making it less "expensive" for the social planner to allocate non-traded goods to present generations than to future. In the absence of sectoral adjustment costs, the industrial structure should be changed at once, leaving all generations equally well off.

The structure of the rest of the paper is as follows. The next section takes a quick look at some examples of large adverse trade shocks. Section 3 analyzes the special case of no sectoral adjustment costs with particular emphasis on the distinction between private and public shocks. In Section 4 we introduce training costs in the industry producing internationally traded goods. We investigate how such costs modify the previous effects by studying the socially optimal policy response to an adverse external shock. In Section 5 we summarize our conclusions and briefly discuss some limitations and extensions.

2. REAL WORLD EXAMPLES OF ADVERSE TRADE SHOCKS

In the developing world, examples of dramatic trade shocks are abundant. Collier and Gunning (1999) have collected 23 case studies from Africa, Latin America and Asia. Examples include the oil shocks in Venezuela and Indonesia in the 1980s and mining shocks in Zambia, Botswana and Bolivia. All these shocks affected government revenues adversely. The most extreme example seems to be Venezuela, where 90 percent of the export revenues and 60 percent of the government's total revenues used to come from the oil sector (Hausmann, 1999). During the 1980s, Venezuela's GDP per capita had fallen by 18 percent.

Norway built up a large petroleum industry during the 1970s and 1980s, see Table 1. In 1986, the oil price shock amounted to a 10 per cent decline in national income and a dramatic deterioration of the current account. The shock triggered a speculative attack followed by devaluation and a more austere monetary and fiscal policy. As can be seen from Table 1, the decline in the terms of trade was quite persistent. The shock reduced the petroleum wealth, i.e. the estimated present value of future cash flow from the petroleum sector from more than 250 per cent of GDP in 1985 to less than 100 per cent of GDP in 1987.[9] Close to 90 per cent of the Norwegian petroleum wealth accrue to the government. This explains the decline in the fiscal surplus from 8.1 percent in 1985 to 1 percent in 1987, despite the fiscal policy restraint. By the end of the 1980s, the Norwegian economy went into a severe recession. At the same time, rapid technological progress spurred considerable growth in the output of oil and gas, see the last row of Table 1. This positive "quantity shock" restored the previous export revenues and permitted a more expansionary fiscal policy stance to fight the recession. The structural adjustment process after the oil price shock appears to have been quite slow. During the recession labor were laid off both in traded and non-traded sectors and unemployment increased (see Table 1). It was not until the first half of the 1990s that the real depreciation had a visible effect on the sector producing traded goods.

Table 1. Norway – Selected macroeconomic indicators

	1983-85	**1986-88**	**1989-91**	**1992-94**	**1995-97**
Terms of trade (1984=100)	97.8	75.6	75.6	69.6	70.5
Export value of petroleum, per cent of GDP	16	9	13	12	14
Current account, percent of GDP	4	–5	2	3	5
Annual employment growth, per cent	1.2	1.7	–1.6	0.3	2.0
Unemployment rate, per cent	3.0	1.9	4.3	5.4	4.1
Annual production of crude oil, million metric tons	34.5	49.3	83.5	116.9	150.6

Note: Figures are average of annual values, Sources: Statistics Norway, Ministry of Finance.

In Finland, the exports of textiles to the Soviet Union collapsed in 1991, triggering an economic depression from which a partial recovery started in the late 1990s (Honkapohja and Koskela, 1999). A severe economic crisis also hit Sweden during this period (Lindbeck at al., 1994). At the same time, the exchange rate peg to the German mark increased the Nordic real interest rate

[9] The cited estimates were calculated by Statistics Norway, see ”Okonomiske analyser, no. 1, 1989”.

considerably due to the tight monetary policy of the Bundesbank after the German unification. Moreover, bad policies and poor institutions, particularly in the financial sector and labor markets, may also have played an important role. Although there are important differences among the three Nordic countries, the basic economic mechanism was similar. Before the shocks, a boom had expanded the non-traded goods sector and appreciated the real exchange rate. When the adverse shocks hit, the current accounts deteriorated, the real exchange rate depreciated and domestic absorption dropped, revealing a structural imbalance between the sectors producing traded and non-traded goods. The ensuing sectoral adjustment processes were however gradual and time-consuming.[10] Although a preceding boom in the non-traded sector is not essential for our analytical story, the boom bust cycle certainly exacerbated the structural imbalance triggered by the adverse external shocks and therefore reinforced the adjustment problem which is highlighted in the present paper.

Another common feature is also noteworthy: In Norway, Finland as well as Sweden, the crises had dramatic adverse consequences for government revenues, welfare spending and net wealth, both directly due to government involvement in export industries, and indirectly through the tax-transfer system. In Sweden and Finland, the public budget stance deteriorated from small surpluses in the late 1980s to huge deficits amounting to 13 and 10 percent of GDP in 1993, respectively. This naturally brings the question of fiscal policy adjustment to the forefront.

3. THE CASE OF NO ADJUSTMENT COSTS

We consider a continuous-time model of a small open economy. The model consists of firms, overlapping generations of households, and a government that levies lump sum taxes on households to service its net debt. Domestic agents are price takers in all markets and have free access to international lending and borrowing. There are no private intergenerational transfers. Hence, the government's debt policy has real effects.

There are three production sectors, denoted *N*, *T* and *R* respectively. The R-sector can be thought of as a “resource sector”. It produces an export commodity, Q_R, which is sold for an

[10] To illustrate, in Finland it took Nokia fifteen years to become an internationally competitive company producing cellular phones.

exogenous price p_R . By an adverse trade shock we mean an unanticipated drop in p_R . The N-sector produces non-traded goods, Q_N , and the T-sector produces other traded goods than the R-good, denoted Q_T (the *numeraire* good). The corresponding exogenous real rate of interest is equal to $r > 0$.

We assume for simplicity that physical capital is industry-specific and fixed and that labor is the only input that can move between sectors. Later, we assume that the expansion of the labor force of the T-sector involves training costs, which act as strictly convex adjustment costs. This abstraction permits a sharper focus on the intergenerational welfare effects of fiscal policy. An alternative, but analytically more demanding route, would be to consider sectoral adjustments of capital stocks as well, an extension that would require numerical simulations.[11]

3.1. Production and consumption

Let $L_i(t)$ be the aggregate labor input in sector i at time t, $i = T, N, R$. To simplify, we abstract from capital in the N-sector and assume $Q_N(t) = L_N(t)$. In equilibrium, $p(t) = w(t)$, where $p(t)$ is the relative price of Q_N and $w(t)$ the real wage in terms of traded consumption goods. In the T- and R-sectors, the production functions are $Q_i(t) = F_i(L_i(t))$, where $F_i' > 0$ and $F_i'' < 0$, $i = T, R$. The production functions are strictly concave due to fixed capital.[12] Aggregate real profits in terms of the tradable consumption good are $\Pi_i = p_i Q_i - wL_i$. The first-order conditions for profit maximization, $p_i F_i' = w$, yield the demands for labor $L_i = L_i(\frac{w}{p_i})$ and the real profit functions $\Pi_i(\frac{w}{p_i})$, $\Pi_i' = -L_i$. The values of the fixed capital stocks ($\Omega_i(t)$) are the present values of the respective flows of profits Π_i. The rate of change of $\Omega_i(t)$ is

$$(1) \qquad \dot{\Omega}_i = r\Omega_i - \Pi_i\left(\frac{w}{p_i}\right), \quad i = T, R.$$

An adverse external shock will clearly trigger an immediate depreciation of $\Omega_R(0)$, both directly and through an induced wage effect. Below we shall also consider the special case in which the R-sector does not use labor ($L_R = 0$). Then profits are $\Pi_R = p_R Q_R$, where Q_R is exogenous.

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[11] See for example Buiter (1987) and Macklem (1993) which both take costs of capital stock adjustments and overlapping generations into account.
[12] For convenience, we also assume that in both the T- and the R-sector, the marginal productivity of labor goes

Turning to the behavior of households, each individual supplies one unit of labor per time unit and faces a constant instantaneous probability of death, $\pi > 0$. A new cohort is born at each instant of time and its size (at birth) is normalized to π. Hence, both the population mass and the aggregate labor supply are equal to 1. Following Blanchard (1985) and Buiter (1988), expected utility of a person born at time $s \leq t$ is:

$$E_t[u(s,t)] = \int_t^{\infty} \log\left(c_T(s,z)^{\eta} c_N(s,z)^{1-\eta}\right) e^{-(\pi+\delta)(z-t)} dz .$$

Here η is the constant expenditure share of traded goods ($0 < \eta < 1$), and $\delta > 0$ is the pure rate of time preference. The individual real rate of return is $r + \pi$. We assume that $\pi > r - \delta$. The net wage income, $(w(t) - \tau(t))$, is independent of age. $\tau(t)$ is a lump-sum tax levied on all individuals alive at time t. Since the aggregate labor supply is 1, the aggregate wage and tax bills are also equal to $w(t)$ and $\tau(t)$. Let $c(s,t) = c_T(s,t) + w(t)c_N(s,t)$ be individual consumption expenditure in terms of traded goods. Optimal consumption is proportional to total wealth: $c(s,t) = (\delta + \pi)[a(s,t) + h(t)]$, where $a(s,t)$ and $h(t)$ are private non-human and human wealth, respectively. The latter is independent of age and is equal to the aggregate human wealth of the generations presently alive, denoted $H(t)$:

(2) $$H(t) = \int_t^{\infty} [w(z) - \tau(z)] e^{-(r+\pi)(z-t)} dz.$$

Let $C(t)$ be aggregate consumption expenditure: $C(t) = C_T(t) + w(t)C_N(t)$. It can also be expressed as $C(t) = (\delta + \pi)[H(t) + A(t)]$, where $A(t) = B(t) + \Omega_T(t) + (1-s)\Omega_R(t)$ is aggregate private non-human wealth. Here s denotes the exogenous government share of Ω_R ($0 \leq s \leq 1$). B denotes other private assets. Clearly, $C_T = \eta C$ and $C_N = [(1 - \eta)/w]C = L_N$. The rates of change of aggregate consumption and private non-human wealth can be written

(3) $$\dot{C} = (r - \delta)C(t) - \pi(\pi + \delta)A(t) ,$$

(4) $$\dot{A} = rA(t) + w(t) - \tau(t) - C(t).$$

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to infinity when labor input approaches zero.

The sole objective of the government is to run a tax-transfer program that affects the consumption of different generations. In addition to the flow of lump-sum taxes ($\tau(t)$) we also introduce a one-time wealth tax (Z_0) at time zero. As will be explained below, this tax (or subsidy) is necessary for the achievement of a first-best optimum. We define $\Omega_G = B_G + s\Omega_R$ as net government wealth. Here $B_G(t)$ is other government assets. $B_G(0)$ includes the tax Z_0. It follows that

(5) $$\dot{B}_G = rB_G(t) + \tau(t) + s\Pi_R\left(\frac{w(t)}{p_R}\right)$$

We write the intertemporal budget constraint of the government as

(6) $$B_G(0) = -\int_0^\infty \tau(t)e^{-rt}dt - s\Omega_R(0).$$

National non-human wealth is $\Omega = \Omega_G + A = \Omega_T + \Omega_R + \Omega_F$, where Ω_F is the stock of net foreign assets, $\Omega_F = B + B_G$. $\Omega_F(0)$ is given by history.

3.2. Equilibrium

Domestic market equilibrium implies

(7) $$L_N(t) + L_T(t) + L_R(t) = 1,$$

(8) $$(1-\eta)C(t) = w(t)L_N(t).$$

Using (7) and (8), we can express the real wage as an increasing function of C and p_R:

(9) $$w(t) = W(C(t), p_R), \qquad \frac{\partial W}{\partial C} = \frac{1-\eta}{1+(\beta-1)L_T + (\beta_R - 1)L_R} > 0.$$

In the expression for $\frac{\partial W}{\partial C}$, β and β_R are the wage elasticities of labor demand in the T- and R-sectors, respectively: $\beta(w) = \frac{-L_T' w}{L_T}$, $\beta_R(w) = \frac{-L_R' w}{L_R}$. Let $\varepsilon(C, p_R)$ denote the partial elasticity of W with respect to C. It is straightforward to show that $\varepsilon < 1$. Moreover, $\frac{\partial W}{\partial p_R} > 0$. A fall in p_R will therefore release labor from the R-sector and reduce the equilibrium wage.

For welfare comparisons, the relation between the utility of the consumption basket $U = C_T^{\eta} C_N^{1-\eta}$ and C is important. Differentiating, and using that $\dot{w}/w = (\dot{C}/C)\varepsilon$, yields

(10) $$\frac{\dot{U}}{U} = [1-(1-\eta)\varepsilon]\frac{\dot{C}}{C} ,$$

where $1 - (1 - \eta)\varepsilon > 0$. Therefore, U will always change in the same direction as C.

Using (9), (4) and $B = A - \Omega_T - (1-s)\Omega_R$, we obtain the following dynamic system:

(11a) $$\dot{C} = (r-\delta)C(t) - \pi(\pi+\delta)[B(t) + \Omega_T(t) + (1-s)\Omega_R(t)],$$

(11b) $$\dot{B} = rB(t) + \Pi_T(w(t)) + (1-s)\Pi_R\left(\frac{w(t)}{p_R}\right) + w(t) - \tau(t) - C(t),$$

(11c) $$\dot{\Omega}_T = r\Omega_T(t) - \Pi_T(w(t)),$$

(11d) $$\dot{\Omega}_R = r\Omega_R(t) - \Pi_R\left(\frac{w(t)}{p_R}\right).$$

Here $C(0)$, $\Omega_T(0)$ and $\Omega_R(0)$ are all jump variables, while $B(0)$ is predetermined.

To pin down an intertemporal equilibrium, the tax policy must be specified. As a natural benchmark, we assume $B_G(t) = B_G(0)$ for all t. It follows from (5) that $\tau(t) = -rB_G(0) - s\Pi_R\left(\frac{w(t)}{p_R}\right)$. Substituting into (11b) yields

(11b)' $$\dot{B} = rB(t) + \Pi_T(w(t)) + \Pi_R\left(\frac{w(t)}{p_R}\right) + w(t) + rB_G(0) - C(t),$$

where $w(t)$ is given by (9). In looking for stationary equilibria, setting $\tau(t) = \tau^*$ and $\dot{C} = \dot{A} = 0$ in (3) and (4), yield

(12) $$C^* = \frac{w^* - \tau}{1-rk},\ \ A^* = kC^*,\ \ k = \frac{r-\delta}{\pi(\pi+\delta)},$$

where asterisks denote stationary equilibrium values. The assumption $\pi > r - \delta$ guarantees that $rk < 1$. The stationary tax is $\tau^* = -rB_G^* - s\Omega_R(\frac{w^*}{p_R}) < w^*$. In the special case $r = \delta$, the constant k is zero. Then $C^* = w^* - \tau^*$ and $A^* = 0$.[13] In any feasible stationary equilibrium, $L_N^* < 1$.[14] Using (8) and (12), this is equivalent to the condition

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[13] The case $r < \delta$ ($k < 0$) is less interesting because it involves $A^* < 0$, and will not be considered in what follows.
[14] Our assumptions about the production functions imply that w goes to infinity when L_N approaches 1.

$$\frac{\eta - rk}{1 - rk} > \frac{-\tau *}{w * - \tau *}.$$

Setting $\tau^* = 0$, we see that this condition will not be fulfilled if $rk > \eta$. We therefore assume that $rk < \eta$. Intuitively, this condition excludes equilibrium paths in which insufficient ability to absorb traded goods leads to non-converging accumulation of foreign assets.[15] Using (4), (5) and (12), we obtain the following equation, which implicitly defines stationary consumption expenditure:

$$(13) \qquad C^* - W(C^*, p_R) - rkC^* - rB_G - s\Pi_R\left(\frac{W(C^*, p_R)}{p_R}\right) = 0.$$

It is straightforward to show that $\frac{dC^*}{dp_R} > 0$. In Appendix A1 we show that local saddle-path stability requires that

$$(14) \qquad J \equiv 1 - rk - \frac{\partial W}{\partial C} > 0, \qquad \frac{\partial W}{\partial C} = \frac{1-\eta}{1 + (\beta - 1)L_T + (\beta_R - 1)L_R}.$$

This condition holds for any $\tau * < w*$ if $\beta > \frac{1-\eta}{1-rk}$. We also show in Appendix A1 that if $\tau^* < 0$, $\beta > 0$ is a sufficient condition for $J > 0$. The stability condition is therefore not very restrictive.

Table 2 summarizes the comparative-static results of an adverse price shock. We also report the effects if $L_R = 0$, i.e. no labor shedding from the R-sector. Provided that $L_R > 0$ or $s > 0$, w^* falls and labor moves into the T-sector, increasing Π_T^* and Ω_T^*. A^* falls if $r > \delta$, and remains zero if $r = \delta$. In the case $L_R = 0$ and $s = 0$, the shock does not affect the long run equilibrium.

Table 2. Comparative static effects of an adverse wealth shock (a fall in p_R)

	C^*	A^*	w^*	L_T^*	L_R^*	L_N^*	Ω_R^*	Ω_G^*	Ω^*
$L_R > 0$, $s > 0$	–	– (or 0)	–	+	–	?	–	–	–
$L_R > 0$, $s = 0$	–	– (or 0)	–	+	–	?	–	0	– (or 0)
$L_R = 0$, $s > 0$	–	– (or 0)	–	+	0	–	–	–	–
$L_R = 0$, $s = 0$	0	0	0	0	0	0	–	0	0

[15] In terms of the phase diagram in Figure 1, we can interpret the case $\eta < rk$ as a situation where the $\dot{C} = 0$ locus is always above the $\dot{A} = 0$ locus such that no stationary equilibrium exists. Then the economy's growth path is between the two loci, and both C and A grow over time.

3.3. The dynamic effects of wealth shocks and fiscal policy

In this section, we show that the intergenerational welfare effects of shocks to public and private wealth have opposite signs. Even though there are four state variables in (11), the dynamic effects can be illustrated by a remarkably simple phase diagram in C and A. Figure 1 shows the adjustment to an adverse shock to *government* wealth (s = 1) in the case $r > \delta$.[16] Condition (14) implies that the slope of the $\dot{C} = 0$ locus is larger than the slope of the $\dot{A} = 0$ locus.

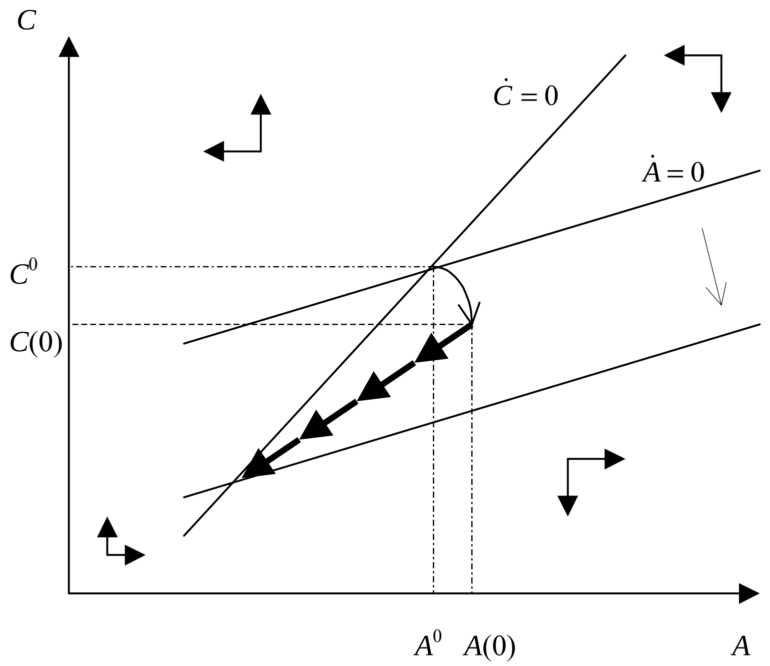

Figure 1. Government wealth shock

We assume that τ is increased at once to keep B_G constant. This shifts the $\dot{A} = 0$ locus downwards. The impact effect is a fall in $C(0)$ and $w(0)$, shifting labor from the N- and R- to the T-sector.[17] Since

[16] The slopes of the $\dot{C} = 0$ and $\dot{A} = 0$ loci are given by $\pi(\pi+\delta)(r-\delta)^{-1}$ and $r(1 - \frac{\partial W}{\partial C})^{-1}$ respectively. Because $0 < \frac{\partial W}{\partial C} < 1$, the $\dot{A} = 0$ locus slopes upwards.

[17] It is possible that $C(0)$ increases on impact. We can write $C(0) = (\delta + \pi)(H(0) + A(0))$. The gain from appreciation of fixed capital may outweigh the human capital loss of the present generations since the discount rate is higher for the latter. Hence, $C(0)$ may jump upwards.

present and future profits increase, $\Omega_T(0)$ and $A(0)$ shift upwards. The adjustment process involves decreasing $A(t)$, $w(t)$ and $C(t)$ as well as a current account deficit. [18] More labor moves into the T-sector. Younger and unborn generations are clearly worse off than older generations. The present wealth-owners at time zero bear the lightest burden because they run down their initial assets.[19] Declining C and w also push up the consumption real rate of interest (r_C):

$$(15) \qquad r_C(t) = r - (1-\eta)\frac{\dot{w}(t)}{w(t)}.$$

This reflects the demand pressure generated by the shift in the intergenerational distribution to the benefit of present generations.

A corresponding adverse shock to *private* wealth (s = 0) triggers a different adjustment process. Assume first that $L_R = 0$, i.e. no labor shedding. From the last line of Table 2, we know that the stationary equilibrium does not change, i.e. neither of the loci in Figure 1 shift. However, $C(0)$ and $A(0)$ jump downwards on the initial stable trajectory. The real wage also drops on impact, triggering a shift of labor towards the T-sector. During adjustment, both $C(t)$, $w(t)$ and $A(t)$ increase to restore the initial equilibrium, as labor gradually moves back to the N-sector.[20] Now the *present* generations are worse off than younger and unborn generations and r_C is lower than r. To summarize:

PROPOSITION 1. *If there are no sectoral adjustment costs, $L_R = 0$, and fiscal balance without any initial wealth tax or subsidy, an adverse shock to government wealth leads to current account deficits, an increase in the consumption rate of interest and declining intergenerational welfare. An adverse private wealth shock has the opposite qualitative effects on the current account, the consumption real rate of interest, and intergenerational welfare*.

The fundamental reason why the effects are opposite is the absence of private transfers between different age groups. This prevents the present generations from sharing the burden of the private wealth shock with future unborn generations through voluntary transfers or risk-sharing

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[18] To see this, note that the current account surplus can be written $\dot{\Omega}_F = \dot{A} - \dot{\Omega}_T - \dot{\Omega}_R + \dot{B}_G$. Since the three first terms on the RHS are negative and the last one is zero, Ω_F must decline along the stable trajectory in Figure 1.

[19] The isolated effects of labor shedding from the R-sector on w^* and C^* are ambiguous if the government owns the R-sector wealth (s = 1) and the demand for labor in the latter sector is elastic. Then the rest of the economy must absorb more labor, but Ω_R declines less, reducing the size of the necessary tax increase. The latter effect also reduces the need for labor transfer from the N- to the T-sector.

transactions. Each newborn generation starts with a zero initial stock of wealth independent of previous private shocks. As the present generations fade away, the economy therefore approaches the old pre-shock equilibrium. In this model, only the government can spread the burden of a shock between present and future generations by raising the lump sum tax permanently. Still, even though all present and future generations share the same tax burden, present generations can enjoy higher consumption and welfare than future generations by running down initial, excessive assets.[21]

Proposition 1 assumed that the R-sector did not use labor. Suppose now that $L_R > 0$, and that an adverse private wealth shock ($s = 0$) triggers labor shedding in addition to the effects discussed above, see Table 2. Since a fall in p_R shifts the wage function $W(C, p_R)$ downwards, the $\dot{A} = 0$ locus must also shift downwards, reducing C^* and A^* in Figure 1. Intuitively, increased supply of labor to the rest of the economy requires a permanent cut in the real wage. However, since the wealth shock has a greater effect on present generations than on future, the post-jump values of $C(0)$, $A(0)$ and $w(0)$ overshoot their stationary levels. Therefore, labor initially moves from the R-sector and N-sector, and then gradually back to the N-sector.[22]

Mansoorian (1991) analyzed the effects of a positive shock to private wealth (a resource discovery) in a similar set-up, but he concluded that the long-run wage effect would be negative, making future generations worse off than if no resources had been discovered in the past. In our model, an increase in p_R triggers a positive steady state wage effect, benefiting future generations. This difference is due to two assumptions behind Mansoorian's model, first that the R-sector does not employ labor, and secondly that the R-sector attracts non-tradeable capital from the T-sector (the manufacturing sector in his model). This capital movement reduces the marginal product of labor in the T-sector, reducing the long-run equilibrium wage for any given level of aggregate consumption expenditure. In our model, however, the increased demand for labor from the R-sector pushes the stationary wage upwards.

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[20] Since A increases and Ω_T and Ω_R decline, the country will now run surpluses on the current account.
[21] This effect is magnified by, but does not depend on the existence of the initial windfall gain from fixed capital in the T-sector.
[22] The labor shedding effect was important in the Finnish crisis, but not in the Norwegian, see section 2. In Norway, the oil sector hardly reduced its labor force in the years after the fall in the oil price in 1986.

As discussed in Section 2, adverse external shocks often involve changes in both private and public wealth. The net effect on intergenerational welfare is ambiguous. Moreover, Proposition 1 implies that there must exist a particular government share ($\hat{s}$) of the R-sector wealth that would exactly balance the two opposing forces of an adverse shock on the intergenerational distribution. In this special case the wealth shock would immediately move the economy to a new stationary equilibrium. If $L_R = 0$, this particular wealth share is:

$$\hat{s} = \frac{J}{J + rk + L_T^* \frac{\partial W}{\partial C}}, \qquad \left(J = 1 - \frac{\partial W}{\partial C} - rk > 0 \right). \tag{16}$$

It is instructive to see what this special case involves. The government wealth share affects how much τ^* must be raised permanently in order to balance the budget after the shock. A large s means a large increase in τ^* which again has strong effects on C^* and A^*. The share $\hat{s}$ in (16) has the property that the depreciation in $A(0)$ exactly matches the new A^*. Then $C(0)$ will jump downwards to C^* as well. This result is important for our analysis of optimal fiscal policy in Section 3.4 below.

We now look at how fiscal policy redistributes welfare over time. A natural policy experiment is a one-time wealth tax $dZ_0 > 0$ at time zero combined with a permanent cut in the lump sum tax $d\tau^* = -rdZ_0 < 0$; see (6). In the phase diagram in Figure 1, this shifts the $\dot{A} = 0$ locus upwards, increasing C^* and A^*. $C(0)$ and $A(0)$ must jump downwards, however, since increased future consumption comes at the expense of the welfare of present wealth-owners. Such a fiscal policy could eliminate the bias in the intergenerational welfare effects of a government wealth shock. Correspondingly, a one-time wealth subsidy ($dZ_0 < 0$), combined with a permanent increase in τ^*, could eliminate the corresponding bias resulting from an adverse private wealth shock.

3.4. Optimal fiscal policy

We now ask what the *optimal* fiscal policy looks like. In the absence of a representative consumer, we introduce a social planner equipped with a utilitarian social welfare function.[23] Following Calvo and Obstfeld (1988), let social welfare be given by

[23] The underlying assumption is that consumers --although privately maximizing utility derived from their own

$$\Psi(0) = \int_0^{\infty} \left(E_0\left[u(s,s)\right]\right) e^{-\rho s} ds + \int_{-\infty}^{0} \left(E_0\left[u(s,0)\right]\right) e^{-\rho s} ds . \tag{17}$$

In (17), the first term on the RHS represents the expected lifetime utilities of unborn generations, and the second term is the expected utilities over the remaining lifetime of the generations alive at time zero. The social rate of time preference is $\rho > 0$. To simplify the welfare analysis, we assume that $\rho = r$ in what follows. This means that the social planner cannot increase social welfare if the economy is in a stationary equilibrium at the outset. Optimal plans will therefore either be a stationary equilibrium, or involve a transition to one.

To characterize optimal plans, it is useful to focus on r_C, the consumption real rate of interest; see (15). In any stationary equilibrium, $r_C = r$. Suppose now that an optimal plan involves a transition to a stationary equilibrium. For example, if $r_C(t) > r$, the social planner must have allocated welfare such that generations in steady state enjoy *more* welfare than present generations. In other words, C and U should increase over time, see (10). Conversely, if the optimal plan involves $r_C(t) < r$, the optimal C and U should decrease and future generations should have lower welfare than the present. Using (9), (10) and (15), the difference $(r - r_C)$ can be expressed as

$$r - r_C(t) = (1-\eta)\varepsilon \frac{\dot{C}}{C} . \tag{18}$$

It follows from (18) that along any transition path, the sign of $(r - r_C)$ is always the same as the sign of $\dot{C}$. But as explained above, a welfare optimum requires opposite signs. Therefore:

PROPOSITION 2. *If there are no sectoral adjustment costs, and $\rho = r$, the welfare optimum is always a stationary equilibrium.*

We now ask how the two tax policy instruments (τ^*, Z_0) should be set to generate the first-best solution after a permanent drop in p_R ($dp_R < 0$). It is straightforward to show that we obtain the following optimal fiscal policy, assuming for simplicity that $L_R = 0$:

consumption only -- still care, as members of society, about society's future. This justification for a social welfare function is emphasized by Blanchard and Fischer (1989, pp. 98). It would be more satisfactory, however, to endogenize political behavior by a voting mechanism, but this is beyond the scope of the present paper.

(19a) $$\frac{d\tau^*}{dp_R} = \frac{-JQ_R}{J + rk + L_T^* \dfrac{\partial W}{\partial C}},$$

(19b) $$\frac{dZ_0}{dp_R} = \frac{J - s\left(J + rk + L_T^* \dfrac{\partial W}{\partial C}\right)}{r\left(J + rk + L_T^* \dfrac{\partial W}{\partial C}\right)} Q_R .$$

The expressions for $J > 0$ and $\frac{\partial W}{\partial C}$ are given by (14). From (19a), we see that the optimal change in τ* is positive and independent of s. This is natural, since the optimal welfare effect on unborn generations should not depend on the initial ownership structure. The optimal one-time wealth tax at $t = 0$ is sensitive to s, however, see (19b). If $s = 0$, $dZ_0 < 0$ because now the government budget constraint requires that $dZ_0 = -d\tau^*/r$. If $s = 1$, the government is hit by the adverse shock and needs extra tax revenues to fulfill its solvency requirement ($dZ_0 > 0$).

In a special case, the government's wealth share is such that the optimal one-time tax is zero. Setting $dZ_0 = 0$ in (19b), we see that this case corresponds to $s = \hat{s}$, see (16). To summarize:

PROPOSITION 3. *Assuming zero sectoral adjustment costs, $L_R = 0$ and $\rho = r$, the optimal fiscal policy response to an adverse public or private wealth shock is to increase τ* permanently. In addition, current wealth owners receive a one-time positive wealth transfer in the case of a private wealth shock and pay a one-time tax in the case of a shock to public wealth. The one-time transfer or tax is always smaller than the wealth shock itself and is zero if the shock is distributed between the private and public sector as in equation (16).*

4. COSTS OF SECTORAL ADJUSTMENT

The preceding analysis assumed that the T-sector could expand instantly in response to an adverse shock. We now take into account that sectoral adjustment could involve significant costs that prevent jumps in the industrial structure. As a stand-in for various kinds of adjustment costs, we introduce training costs in the *T*-sector. As explained below, the logic of our argument is not dependent on this particular abstraction, however. We assume that experienced workers from the *T*-sector must train new workers. We also assume that knowledge is firm specific. Firms are therefore willing to train new workers without charge and no wage differential arises between workers in different sectors.[24] For simplicity, we only consider training costs in the T-sector. Abstracting from costs of adjusting the N-sector is not a critical assumption because our focus is on the dynamic effects of shocks that warrant a larger T-sector.

4.1. Training and production

The production functions are the same as before, i.e. $Q_N = L_N$, $Q_R = F_R(L_R)$ and $Q_T = F_T(L_T)$. In addition to production workers (L_T) in the T-sector, however, some workers are instructors. Let $I_T(t)$ denote the number of instructors. The training technology is linear: $I_T(t) = \alpha I(t)$, where $I(t) \geq 0$ is the gross flow of new workers entering the T-sector. The parameter α is the number of instructors required to train one new worker per unit of time, and measures the size of the adjustment cost. Let the state variable $X(t) = L_T(t) + I_T(t)$ be the total labor force in the T-sector. The accumulation equation for $X(t)$ is

(20) $$\dot{X} = I(t) - \pi X(t),$$

where $\pi X(t)$ is "replacement investment". The firms' cash flow is $\Pi_T^a = F_T(X - \alpha I) - wX$. For a given real wage path $w(.)$, firms maximize the value of fixed capital with respect to $I(.)$,

(21) $$\Omega_T^a(0) = \int_0^\infty \Pi_T^a e^{-rt}\, dt\,,$$

subject to (20), $X(0) = X^0$ and $I \geq 0$. Letting $\mu(t)$ be the costate variable associated with (20) and assuming that $I(t) \geq 0$ does not bind, necessary conditions for an optimum are: (i) $\mu(t) = \alpha F_T'$ and (ii) $\dot{\mu} = w(t) - mF_T'$, where $m = 1 - \alpha(r + \pi) > 0$.[25] Since $\mu(t)$ is the opportunity cost of the services of production workers, it can be interpreted as the marginal training cost. Due to diminishing returns to labor, $\mu(t)$ decreases when $Q_T(t)$ increases.

It is convenient to use the marginal product of labor $\lambda(t) = \mu(t)/\alpha = F_T'(L_T(t))$ as a state variable. This permits us to write $L_T(t) = L_T(\lambda(t))$, where $L_T(.)$ is the demand for labor function used in

[24] This assumption is not crucial, but simplifies the analysis. An alternative assumption would be industry-specific knowledge involving a separate market for training and intersectoral wage differences; see Steigum (1984).

[25] If m is negative, a stationary equilibrium with a positive Q_T does not exist because the marginal return from

Section 3. However, the former first-order condition $F_T' = w$ does not apply when the training cost is positive. The time derivative of $\lambda(t)$ is

(22) $$\dot{\lambda} = \frac{w(t) - m\lambda(t)}{\alpha}, \qquad m = 1 - \alpha(r + \pi) > 0.$$

Since $I_T = X - L_T(\lambda)$, (20) can be rewritten as a function of $\lambda(t)$ and $X(t)$:

(23) $$\dot{X} = -\frac{L_T(\lambda(t))}{\alpha} + \left(\frac{1}{\alpha} - \pi\right) X(t).$$

4.2 Equilibrium with training costs

The introduction of training costs does neither change (3) and (4), or the equilibrium condition for non-traded goods (8). Since the expressions for C^* and A^* in (12) are derived from (3) and (4), they are also the same as before. The labor market equilibrium condition (7) must however be replaced by $L_N(t) + X(t) + L_R(t) = 1$. In what follows, we assume that $L_R = 0$. Profits from the R-sector, $p_R Q_R = r\Omega_R$, are therefore constant. Private wealth is $A(t) = B(t) + \Omega_T^a(t) + (1 - s)\, p_R\, Q_R / r$. Using that $L_N = 1 - X = C_N = [(1 - \eta)w^{-1}]C$, the new wage function is:

(24) $$w(t) = \frac{(1-\eta)C(t)}{1 - X(t)}.$$

The cash flow can now be expressed as a function of the three state variables $\lambda(t)$, $C(t)$ and $X(t)$:

(25) $$\Pi_T^a(t) = F_T(L_T(\lambda(t)) - \frac{(1-\eta)C(t)X(t)}{1 - X(t)}.$$

The expression for the capital gain is $\dot{\Omega}_T^a = r\Omega_T^a(t) - \Pi_T^a(t)$. Using (3), (4), (22)-(25) and $B = A - \Omega_T^a - (1-s)\Omega_R$, we obtain the following system:

(26a) $$\dot{C} = (r - \delta)C(t) - \pi(\pi + \delta)[\Omega_T^a(t) + B(t)],$$

(26b) $$\dot{\Omega}_T^a = r\Omega_T^a(t) - F_T\big(L_T(\lambda(t))\big) + \frac{(1-\eta)C(t)}{1 - X(t)} X(t),$$

(26c) $$\dot{B} = rB(t) + F_T\big(L_T(\lambda(t))\big) - \eta C(t) - \tau,$$

training an additional worker (F_T') is smaller than the stationary rental training cost, $\alpha(r + \pi)F_T'$.

(26d) $\alpha\dot{X} = (1-\alpha\pi)X(t) - L_T(\lambda(t)),$

(26e) $\alpha\dot{\lambda} = -m\lambda(t) + \frac{(1-\eta)C(t)}{1-X(t)}.$

In (26), $C(0)$, $\Omega_T^a(0)$ and $\lambda(0)$ are jump variables, while $B(0)$ and $X(0)$ are given by history. The two last equations in (26) are written in a form that facilitates a comparison with the case of a zero adjustment cost. If $\alpha = 0$, we see that both equations vanish, i.e. $X(t) = L_T(t)$, $I_T(t) = 0$, and $\lambda(t) = w(t)$. Hence, the old labor demand function $L_T = L_T(w(t))$ and the wage function (9) apply, implying that $\Pi_T^a = \Pi_T$ and $\Omega_T^a = \Omega_T$. If $\alpha = 0$, the first three equations in (26) are therefore identical to (11a) – (11c), assuming $L_R = 0$.

In Appendix A2, we show that the condition for local saddle path stability is very similar to (14) in the case of no adjustment costs. We derive a stationary wage function that basically has the same properties as (9).[26] It is also shown that the long run effects of a drop in p_R are qualitatively the same as in Table 2 in Section 3. As before, shocks to private wealth have no long run effects.

4.3. Sectoral adjustment when *C* is constant.

To gain more insight into the sectoral adjustment process involving a growing *T*-sector $(\dot{X} > 0)$, we first look at a special case that permits phase diagram analysis with the state variables $X(t)$ and $\lambda(t)$, keeping aggregate consumption $C(t)$ and aggregate private wealth $A(t)$ constant in the background. This requires that $A = kC$ and $C = (1 - rk)^{-1}(w(t) - \tau(t))$. Therefore $w(t) - \tau(t)$ must also be constant. From (24), we see that since $\dot{X} > 0$, the real wage must grow over time to equilibrate supply and demand in the market for non-traded goods. This involves an expected real appreciation. Therefore, $\tau(t)$ must increase along with $w(t)$ to keep *C* constant.[27] The real appreciation leads to a low r_C during the adjustment process, see (15). This reflects that consumers are stimulated to consume more non-traded goods in the short run than in the long.

[26] For the same reason, the assumption $rk < \eta$ is crucial in the case of a positive α as well, see Section 3.2.

[27] We assume that the increasing $\tau(t)$ over time satisfies the solvency constraint of the government. This fiscal policy clearly involves fiscal deficits.

Now, (26d) and (26e) alone describe the dynamic path. Dividing through by α, and linearizing around the stationary equilibrium, yields

$$\text{(27)} \qquad \begin{bmatrix} \dot{X} \\ \dot{\lambda} \end{bmatrix} = \frac{1}{\alpha} \begin{bmatrix} (1-\alpha\pi) & \dfrac{1}{-F_T''} \\ \dfrac{(1-\eta)C^*}{(1-X^*)^2} & -m \end{bmatrix} \begin{bmatrix} X(t)-X^* \\ \lambda(t)-\lambda^* \end{bmatrix}.$$

The phase diagram of (27) is illustrated in Figure 2.

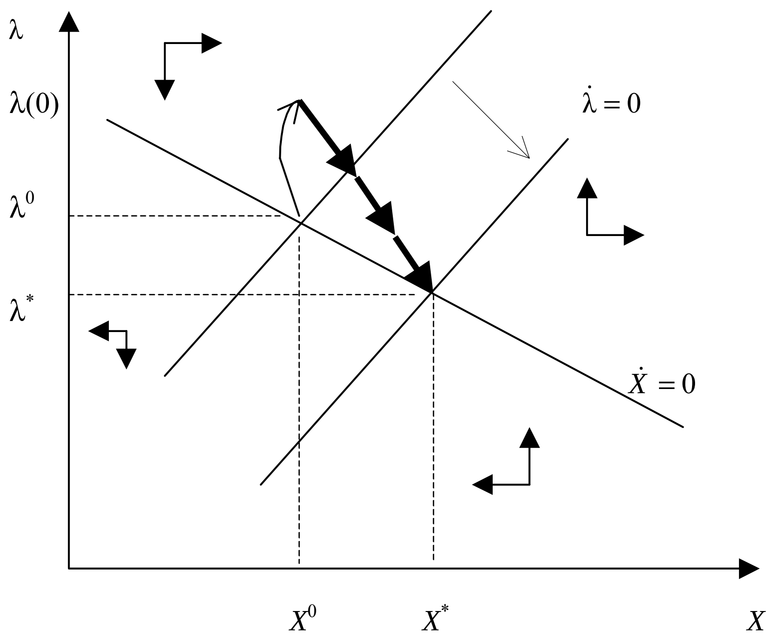

Figure 2. Optimal training and employment in the T-sector

An adverse wealth shock involves a fall in C^*, shifting the $\dot{\lambda} = 0$ locus to the right and increasing X^*.[28] Initially, $X(0)$ and $L_N(0)$ are fixed, and $\lambda(0)$ and $I(0)$ jump upwards. Condition (8) implies:

$$\text{(28)} \qquad (1-\eta)C(0) = w(0)\big(1-X(0)\big).$$

[28] The government's share of the R-sector wealth (s) does not matter because we assume that the government uses the two tax instruments τ and Z_0 to generate constant levels of A and C over time.

From (28), we see that the unfeasibility of a jump in $X(0)$ moves the burden of adjustment on to the real wage $w(0)$. When $C(0)$ drops, $w(0)$ falls proportionally, keeping the demand for non-traded goods in line with the constant supply. Thereafter $w(t)$ gradually increases, reducing the supply of non-traded goods as labor moves out of the sector. The real exchange rate therefore undershoots its long run equilibrium level in contrast to the case of $\alpha = 0$. Another difference is worth noticing: Since C_N falls over time and $C_T = \eta C$ is constant, utility ($U=C_T^{\eta}C_N^{1-\eta}$) declines over time.

4.4. Optimal fiscal policy with adjustment costs

The dimension of system (26) makes it more difficult to analyze the effects of shocks when the fiscal policy adjustment triggers changes in $C(t)$ and $A(t)$ in addition to sectoral adjustment. To simplify, we assume that $r = \delta$ such that $A^* = 0$. Using the welfare function (17) with $\rho = r = \delta$, and assuming $L_R = 0$, we can show that it is optimal to run fiscal deficits in response to an adverse external wealth shock.[29] The properties of the optimal policy can be stated as follows:

PROPOSITION 4. *If there are positive training costs in the T-industry, and $\rho = r = \delta$, the optimal policy response to an adverse shock to public or private wealth is to eliminate the initial effect on private wealth by a tax or transfer at time zero, and introduce an increasing tax function $\tau(t)$ such that $C = w(t) - \tau(t)$ is constant. During adjustment to long run equilibrium, Q_T and L_T grow, there are fiscal and current account deficits, and decreasing intergenerational welfare.*

A formal proof of Proposition 4 is available upon request. We note that since the optimal policy involves constant C and A, it generates the same dynamic adjustment process as in the special case discussed in section 4.3 above, see Figure 2. Clearly, since $r = \delta$, $A^* = 0$. To prove that the optimal policy involves constant C and A, we follow Calvo and Obstfeld (1988) and decompose the planning problem into two stages. Stage one is an "intra-instant" problem of allocating given aggregate levels of $C_T(t)$ and $C_N(t)$ across generations. In optimum, consumption of both traded and non-traded goods should be smoothed perfectly across generations. Stage two is the intertemporal problem. It can be shown that the marginal utility of traded goods should be constant, and that the optimal $C_T(t)$ and

[29] The assumption $r = \rho$ ensures that it is not optimal to accumulate wealth or debt indefinitely, see Blanchard

$w(t)C_N(t)$ are both constant over time.[30] Thus, $C = C_T + wC_N$ is constant as well. Since $C_N(t)$ declines, U falls over time. Hence, the welfare of younger generations is lower than the welfare of older, and lowest in stationary equilibrium.

The optimal intergenerational bias embedded in the optimal policy can be explained in terms of an intertemporal substitution effect. The low consumption rate of interest is due to the fact that the non-traded sector is larger in the short run than in the long. The social planner therefore allocates more welfare to the present generations than to the future.[31]

We note the difference between the optimal policies when $\alpha = 0$ and $\alpha > 0$, compare Propositions 3 and 4. In both cases, the initial effect on $A(0)$ is eliminated by a one-time tax or transfer. If $\alpha = 0$, τ is increased permanently in one step. In the case of $\alpha > 0$, however, τ is increased gradually. Thus, in the latter case, fiscal deficits are part of the optimal plan.[32]

In Section 1 we noted that in the dynamic trade literature, many contributions have assumed some variant of adjustment costs associated with capital accumulation or sectoral reallocation of physical capital. It is therefore natural to ask if our main result would go through under the alternative assumption that the T-sector could expand its capital stock subject to strictly convex adjustment costs, while labor is perfectly mobile. It is easy to see that if capital goods only consists of *traded* goods, such as in the model of Macklem (1993), and (for simplicity) $L_R = 0$, an adverse government wealth shock will first trigger an immediate fall in $w(0)$ and movement of labor into the T-sector. Thereafter, a gradual process of capital accumulation and employment growth in the T-sector will take place, along with an increasing real wage and a low consumption real rate of interest. The optimum policy will still exhibit a constant social marginal utility of traded goods, i.e. both $C_T(t)$ and $w(t)C_N(t)$ will be constant, and the social planner will still use fiscal deficits to allocate more welfare to present

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and Fischer (1989), ch. 2.4.

[30] Constant consumption expenditure was also shown to be optimal in the case of a Cobb-Douglas utility function in a representative agent model with debt neutrality; see Steigum (1992).

[31] Our paper relies on a different mechanism than the well-known tax-smoothing result of Barro (1979). A referee suggested an analogy between the results, because in the present framework, a change in tax policy triggers adjustment costs that have similar effects as the distortionary effects of taxation in Barro's (1979) model.

[32] If we imagine a discrete-time equivalent to our experiment, the initial positive one-time transfer in the case of an adverse private wealth shock would lead to a particularly large budget deficit in the first period. This will also happen if the adjustment cost is zero. Conversely, an adverse shock to government wealth will involve a large budget surplus in the first period in both models.

generations than to the future.[33] Intuitively, our result goes through as long as the cost of adjustment or capital accumulation only involves traded goods. Therefore, if we assume that capital goods are non-traded goods, such as in Morsed and Turnovsky (2000), the extra demand for non-traded goods from the growing T-sector may change the nature of the optimal fiscal policy.

5. CONCLUSIONS

This paper has been inspired by the many real world examples of adverse external shocks having dramatic economic consequences for open economies, developing as well as industrialized. We have however narrowed our focus to the effects of external shocks to national wealth, and to their normative implications for fiscal policy. For the sake of tractability, our model does not address the role of monetary factors in the propagation of external shocks.

Our analysis has two main implications that have not been scrutinized in previous literature. First, shocks to private and government wealth have very different effects both in the short and long run, and it matters a great deal for the optimal design of fiscal policy to what extent the government itself is affected by the wealth shock. An adverse shock to private wealth hurts present generations more than future if the government runs a balanced budget. Therefore, the optimal fiscal policy involves a one-time debt-financed transfer to the present generations. A corresponding shock to government wealth, however, calls for a one-time wealth tax to prevent excessive taxation of future generations.

Second, costs of sectoral adjustment are important for the nature of optimal fiscal policy: In addition to a one-time wealth tax or subsidy, the social planner should run temporary fiscal deficits during the structural adjustment process. This involves an intertemporal substitution effect due to a temporarily low real rate of interest on non-traded goods: Since the non-traded sector is excessive in the short run, the social planner allocates more consumption of non-traded goods to the present generations than to the future. This effect vanishes if there are no costs of sectoral adjustment. Then

[33] Since some labor immediately moves out of the N-sector, the present generations are likely to benefit less from the optimal policy than in the case of no shift in the sectoral allocation of labor at time 0.

the social planner distributes the loss of national wealth evenly among all generations and makes an immediate change in the industrial structure.

Four limitations of our approach should be acknowledged. First, we only consider one initial shock rather than a stochastic process. Second, we only consider investment in human capital, not physical capital. Third, our model does not capture unemployment. And fourth, our model does not capture political constraints that could lead to self-fulfilling policy failure and multiple equilibria.

In regard to the first limitation, our idea was to focus on policy implications of large, infrequent shocks, following the tradition in the literature of dynamic trade models. For this purpose a simpler, non-stochastic modeling approach permits a sharper focus on the structural adjustment problems than a stochastic model could provide. [34]

As to the second limitation mentioned above, introducing capital accumulation and sectoral capital movements would have added realism to the model, but would also warrant a simulation approach (Macklem, 1993). A critical assumption in our model is that the costs of adjustment only involve traded goods. If, for example, we permit capital accumulation in the T-sector that requires substantial resources from the N-sector, the nature of the optimal fiscal policy is likely to change.

Our model is also too simple to capture the mechanisms that often generate unemployment after adverse external shocks in the real world, such as those hitting the Nordic countries in the late 1980s. We think, however, that our finding that fiscal deficits are optimal is a particularly interesting result in a model with neutral money. Still, a model that could capture unemployment in a better way than in terms of an efficient "training process" would be more satisfactory. We conjecture that our main result about optimal fiscal deficits will be strengthened in a model that also generates socially excessive unemployment during the sectoral adjustment process. This is an interesting topic for future research.

Finally, we have not addressed the possibility of self-fulfilling policy failure and multiple equilibria. As shown by Frooth (1988) and Buffie (1995), when there are restrictions on international borrowing, too ambitious policy reforms could fail due to self-fulfilling expectations. Also internal

[34] Implications of a stochastic terms of trade in a two sector model are studied by Dixit (1989), who uses option pricing theory to find the optimal capital allocation policy under adjustment costs, and by Turnovsky (1993) who

political constraints could generate endogenous risk premia and multiple equilibria. This issue has important bearings on the choice between big bang reforms and gradualism, which has received a lot of attention in recent literature. In our model, the optimal policy has a strong flavor of gradualism to protect the welfare of present generations. This policy involves fiscal and current account deficits, which may not be credible due to expectations of borrowing constraints.

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APPENDIX

A1. The case of no adjustment costs

The model consists of the four differential equations (11a), (11b)′, (11c) and (11d). Only one of the state variables, $B(0)$, is not allowed to jump. Linearizing the system around the stationary equilibrium, we obtain the following determinant of the Jacobian D:

(A-1)
$$|D| = \begin{vmatrix} r-\delta & -\pi(\pi+\delta) & -\pi(\pi+\delta) & -(1-s)\pi(\pi+\delta) \\ -1+\frac{\partial W}{\partial C}\left[1-L_T^*-\frac{L_R^*}{p_R}\right] & r & 0 & 0 \\ L_T^*\frac{\partial W}{\partial C} & 0 & r & 0 \\ \frac{L_R^*}{p_R}\frac{\partial W}{\partial C} & 0 & 0 & r \end{vmatrix}.$$

It is straightforward to verify that

(A-2)
$$|D| = -r^2\pi(\pi+\delta)\left[J + s\frac{L_R^*}{p_R}\frac{\partial W}{\partial C}\right] \quad , \quad J = 1-\frac{\partial W}{\partial C} - rk\,.$$

Saddle path stability requires one negative eigenvalue. It is easy two show that two of the eigenvalues are $r > 0$, and that the last ones are a positive and a negative root of a quadratic equation if $J > 0$. Therefore, saddle path stability is established. Moreover, $|D| < 0$.

To see the restriction that condition (14) places on β, the wage elasticity of labor demand in the T-sector, we assume that $L_R = 0$ and substitute the expression for $\frac{\partial W}{\partial C}$ into J. After rearranging the terms we obtain

(A-3) $J > 0 \quad \Leftrightarrow \quad \beta > \frac{1}{L_T^*}\left[\frac{1-\eta}{1-rk} - (1-L_T^*)\right] \equiv \xi.$

We now use (8) and (12) to express L_T* as

(A-4) $$L_T^* = 1 - \frac{(1-\eta)(w^* - \tau^*)}{(1-rk)w^*}.$$

Inserting (A-4) into (A-3), we obtain the following expression for the lower limit on β:

(A-5) $$\xi = \frac{\tau^*}{\frac{(\eta - rk)w^*}{1-\eta} + \tau^*}.$$

We see that if $\tau^* \leq 0$, $\xi \leq 0$. In this case, $\beta > 0$ is a sufficient condition for $J > 0$. Consider next the case $\tau^* > 0$. To see what happens to (A5) if τ^* increases, we must take into account that w^* is a declining function of τ^*. (7), (8) and (12) implicitly define this function:

(A-6) $$\frac{(1-\eta)(w^* - \tau^*)}{1-rk} = w^*(1 - L_T(w^*)), \qquad \frac{dw^*}{d\tau^*} = \frac{-(1-\eta)}{(1 - L_T^*(1-\beta))J} < 0.$$

Using (A-6), it follows from (A-5) that ξ is an increasing function of τ^* if $\tau^* > 0$. The upper limit on τ^* is w^*, in which case $\xi = \frac{1-\eta}{1-rk} < 1$. Therefore, $\beta > \frac{1-\eta}{1-rk}$ is a sufficient condition for $J > 0$.

A2. Sectoral adjustment costs

Dividing through (26d and (26e) by α and linearizing (26) around the stationary equilibrium, we obtain the following determinant of the Jacobian Δ (when s = 1):

(A-7) $$|\Delta| = \begin{bmatrix} r-\delta & -\pi(\pi+\delta) & -\pi(\pi+\delta) & 0 & 0 \\ \frac{w^*}{C^*}X^* & r & 0 & \frac{w^*}{1-X^*} & \frac{F_T'}{-F_T''} \\ -\eta & 0 & r & 0 & \frac{F_T'}{F_T''} \\ 0 & 0 & 0 & \frac{1}{\alpha} - \pi & \frac{1}{-\alpha F_T''} \\ \frac{w^*}{\alpha C^*} & 0 & 0 & \frac{w^*}{\alpha(1-X^*)} & -\frac{m}{\alpha} \end{bmatrix}.$$

The determinant is

(A-8) $$|\Delta| = \frac{r}{\alpha^2}\left\{(\phi - r(r-\delta))\left[\sigma m + \frac{w^*}{(-F_T'')(1-X^*)}\right] - \frac{\phi\sigma m(1-\eta)}{1-X^*}\right\},$$

where $\phi = \pi(\pi + \delta) > 0$ and $\sigma = 1 - \alpha\pi > 0$. To obtain local saddle path stability, we must have two negative eigenvalues. Then, $|\Delta| > 0$. This is equivalent to:

$$\text{(A-9)} \qquad \frac{\alpha^2|\Delta|}{r\phi\left(\sigma m + \frac{w^*}{\left(-F_T''\right)\left(1 - X^*\right)}\right)} = 1 - rk - \frac{1-\eta}{1 - X^* + \frac{w^*}{\left(-F_T''\right)\sigma m}} > 0,$$

where we have used that $(\phi - r(r - \delta))\ \phi^{-1} = 1 - rk$. To interpret the last term in (A-9) we note that σX^* $= L_T(w^*/\ m)$. Therefore, X^* can be expressed as a function of w^*, with

$$\text{(A-10)} \qquad \frac{dX^*}{dw^*} = \frac{-1}{\left(-F_T''\right)\sigma m}, \qquad \sigma = 1 - \alpha\pi.$$

Therefore, the static equilibrium condition (24) defines an implicit wage function:

$$\text{(A-11)} \qquad w^* = \Phi(C^*), \qquad \Phi'(C^*) = \frac{1-\eta}{1 - X^* + \frac{w^*}{\left(-F_T''\right)\sigma m}}.$$

We see that $\Phi'(C^*)$ is equal to the last term in (A-9). Therefore, the stability condition can be expressed in a way that corresponds very closely to the case $\alpha = 0$; see (14):

$$\text{(A-12)} \qquad J^a = 1 - rk - \Phi'(C^*) > 0, \qquad J^a = \frac{\alpha^2|\Delta|}{r\phi\left(\sigma m + \frac{w^*}{\left(-F_T''\right)\left(1 - X^*\right)}\right)}.$$

Since $\Phi(C^*)$ is very similar to the wage function (9), the long run effects of a drop in p_R are qualitatively the same as in the case $\alpha = 0$ (Table 2). We obtain the following comparative static effects:

$$\text{(A-13)} \qquad \frac{dC^*}{dp_R} = \frac{Q_R r\pi(\pi+\delta)}{\alpha\Delta}\left(m\left(\frac{1}{\alpha} - \pi\right) + \frac{w^*}{-F_T''\alpha(1 - X^*)}\right) > 0,$$

$$\text{(A-14)} \qquad \frac{d\Omega_T^{a*}}{dp_R} = \frac{-Q_R\pi(\pi+\delta)w^*}{\alpha C^*\Delta}\left(mX^*\left(\frac{1}{\alpha} - \pi\right) + r\frac{F_T'}{-F_T''}\right) < 0,$$

$$\text{(A-15)} \qquad \frac{dB^*}{dp_R} = -\frac{d\Omega_T^{a*}}{dp_R} + \frac{Q_R r(r-\delta)}{\alpha\Delta}\left(m\left(\frac{1}{\alpha} - \pi\right) + \frac{w^*}{-F_T''\alpha(1 - X^*)}\right) > 0 \quad (\text{for } r \geq \delta),$$

$$\text{(A-16)} \qquad \frac{dA^*}{dp_R} = \frac{dB^*}{dp_R} + \frac{d\Omega_T^{a*}}{dp_R} = \frac{Q_R r(r-\delta)}{\alpha\Delta}\left(m\left(\frac{1}{\alpha} - \pi\right) + \frac{w^*}{-F_T''\alpha(1 - X^*)}\right) \geq 0 \ (\text{for } r \geq \delta).$$

It is straightforward to see that a drop in p_R will increase X^* and reduce λ^*. Hence, w^* declines, and L_T^* increases. Finally, it is easily checked that $d\Omega^* / dp_R > 0$, $d\Omega_F^* / dp_R > 0$, and $dH^* / dp_R > 0$.