Why Gradualism?*

Halvor Mehlum†

Abstract

A Ramsey model for a two-sector economy, comprising a labour intensive non-traded sector and a capital intensive traded sector, is used to analyse the transition following trade liberalization. Liberalization takes the form of removing a tariff wedge that benefited the non-traded sector. This increases overall productivity of capital in the short run, and demand for labour declines. In the presence of a binding minimum real wage this leads to transitional unemployment. In this case, gradualism - in the form of gradually removing the tariff wedge - can be justified. Through gradualism the protection for the labour intensive non-traded sector is prolonged, leading to reduced unemployment in the transition phase.

Keywords: Economic reform, gradualism, two-sector economy, transition, unemployment

1 Introduction

This work formalizes the process of structural adjustment following a trade reform. This is done by combining two of the main models from the neoclassical toolbox; the Heckscher-Ohlin model and the Ramsey model. Using this framework, where the components are so familiar, the analysis can be devoted the main topic, i.e. structural shifts following trade liberalization.

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Within this neoclassical framework, the benefits of trade liberalization follow more or less by definition. The analysis will therefore not question the rationale for trade liberalization itself. Rather the question is: given that trade reform is beneficial in the long run, how should it be designed?

The economy has two sectors, a capital intensive traded sector and a labour intensive non-traded sector. The trade reform is aimed at improving efficiency by removing protection that benefits the non-traded sector. The result of this is a worsening of this sector's profitability, leading to structural shifts. Factors of production, capital and labour, are shifted to the traded sector. The speed of this adjustment is dependent on the timing of the trade reform, and the degree of flexibility of factor prices, i.e. wages. The aim of the article is to analyse the effects on transition of

- inflexible wages, caused by a binding minimum real wage;
- the timing of the trade reform - should trade reform be carried out gradually or in a big bang?

The focus of the analysis is the effects on

- transitional unemployment and welfare.

In doing this, a simple dynamic model is formulated. The economy consists of the two producing sectors, three goods, and a representative optimizing agent. As in the 1-2-3 general equilibrium model (Devarajan and Lewis 1990) all traded goods are exported, and the earnings are used for imports. This imported good, together with the non-traded good, merge in a composite good that is used both for domestic consumption and investment.[1] The factors of production, labour and capital, are homogenous and factor movements takes place without friction.[2] As a result of the latter, the two factor prices are uniform between sectors. This simple intraperiod description has the attractive consequence that the dynamic adjustment can be handled as a standard one-sector Ramsey model.

[1] This model thus represents an alternative to the classical two-sector model (Uzawa 1961), where the two sectors produce capital goods and consumption goods respectively.

[2] Consequenses of departure from this assumption is discussed briefly towards the end of the article.

Several works which study the dynamic adjustments within a traded/non-traded framework, treat the interest rate as fixed by the world market, and allow for a flexible current account.[3] The opposite assumption is made here; the country faces a binding borrowing constraint, imposed either internally or externally. The current account is thus fixed and the interest rate adjusts, equalizing domestic savings and domestic investment.[4] The working of the economy is therefore, in all essential respects, similar to that of a closed economy. As a result, the unattractive, but often used, assumption of strongly convex capital adjustment costs (in order to avoid exploding investment) is not needed. The analysis reveals that:

- during transition following a big bang trade reform, a binding minimum real wages lead to transitional unemployment;
- given a binding minimum real wage, a gradualistic trade reform reduces transitional unemployment compared to a big bang trade reform;
- in a numerical example it is shown that the reduction in unemployment, resulting from gradualism, may well represent a considerable welfare improvement.

The reduction in transitional unemployment, and the possible welfare effect, are strong arguments for gradualism as an alternative to big bang trade reform.

Transitional unemployment following trade reform is also the subject of Agénor and Aizenman (1996). Their model has several similarities to the present one, but differs in two important respects: assuming fixed capital stocks and imperfectly mobile labour. In addition, questions relating to the speed of reform are not addressed. The subject of big bang versus gradualism has been investigated in several works. Edwards and van Wijnbergen (1986) give an argument for gradualism in a two-period model with restricted lending from abroad. They find that a gradual removal of tariffs leads to a postponement of consumption, leading to increased savings and growth. van Wijnbergen (1992) gives a political economy argument in favour of big bang.[5] A big bang tariff reform is assumed to have lower probability of reversal than a gradualistic reform. The scope for harmful

[3] Examples are Dornbush(1983), Mussa (1986), Brock (1988), and Gavin (1990).

[4] Given the current account restriction, prices (interest rate and real exchange rate) adjust to bring about equilibrium. Thus, the fixed current account does not imply output contraction as for example in Rattsø (1994).

[5] Political constraints are discussed briefly in section 4 of the present article.

speculations is thus lower. Mussa (1986) uses a two-sector multiperiod model to discuss several aspects of the timing of trade reform. He goes through a multitude of mechanisms, both giving arguments in favour and against gradualism. The present work can be seen as an elaboration on some of his points, although in a different setting.

The essential characteristics of the economy are:

1. the traded goods sector is capital intensive, relative to the rest of the economy;
2. there is limited access to foreign financing, leading to exogenous current account and endogenous interest rate;
3. the existence of a minimum real wage

These are not necessarily good descriptions of all developing countries. The first point may limit the relevance for Eastern Europe. But for poorer countries, not so devoted to capital intensive import substitution, it can be a fair description. In a more general interpretation, however, the non-traded goods sector also covers the labour intensive public sector. Given this interpretation the analysis will also be relevant for reforms where the tax burden for the private sector is cut and public 'subsidized' employment is reduced[6] - a policy carried out all over the developing world.

The serious indebtedness of many developing countries gives relevance to the second point. 'In the extreme situation of low (or zero) access to foreign capital, a condition faced by many developing countries during 1980s, national saving and domestic investment will be highly (indeed perfectly) correlated.' (Schmidt-Hebbel et al. 1996 p. 93)

A minimum real wage may, for example, be given by efficiency wage considerations or simply by preference for equality in the income distribution. Also, as highly relevant for the poorest developing economies, the minimum real wage may be defined by the mere subsistence level. For the purpose of analytical simplicity it will be assumed, as in Mussa (1986), that a minimum real wage is fixed by law. The rationale for the law, which might be questionable, is not addressed.

The present analysis assumes perfect foresight and frictionless movement of factors of production. Modifications to these assumptions are suggested towards the end. Section

[6] Castanheira and Roland (1996) analyze government downsizing in a model that can be seen as a special case of the present. The working of their model is, in essential respects also similar, although their focus is somewhat different.

4 contains a discussion of possible effects from uncertainty, irreversible investments, and from inclusion of political constraints.

2 A dynamic Heckscher-Ohlin economy.

Production Following the standard Heckscher-Ohlin procedure of formulating the dual of the firm's behaviour, the two-sector two-factor equilibrium conditions are given by

$$C^t(c, w) = p_t \tag{1}$$

$$C^n(c, w) = p_n \tag{2}$$

$$C_1^t X_t + C_1^n X_n = K \tag{3}$$

$$C_2^t X_t + C_2^n X_n = L \tag{4}$$

where $C^t(C^n)$, $p_t(p_n)$, $X_t(X_n)$ denote the unit cost function, product price, and production for the traded (non-traded) sector. K is the total capital stock and L is the total labour supply.

Defining relative producer prices $e = p_t/p_n$ and relative factor prices $\gamma = c/w$, using the Stolper-Samuelson derivatives, give

$$\mathrm{El}_e\, \gamma = \frac{1}{\omega_n - \omega_t} > 1 \tag{5}$$

where the ω are the wage bill's share of total costs ($\omega_n = wL_n/(p_n x_n)$ and $\omega_t = wL_t/(p_t x_t)$).

Using the Rybczynski derivatives and defining the product ratio $\phi = X_t/X_n$, gives

$$\mathrm{El}_k\, \phi = \frac{1}{L_n/L - K_n/K} > 1 \tag{6}$$

That is, increasing the capital stock relative to labour, shifts production to the sector

that is most capital intensive.

With $\mathrm{El}_e\,\gamma$ given by (5), $\mathrm{El}_e\,\phi$ is found by using (1)- (4). Dividing (3) by (4) gives

$$\phi = -\frac{C_1^n - kC_2^n}{C_1^t - kC_2^t} \Rightarrow \mathrm{El}_e\,\phi = \mathrm{El}_e\left(C_1^n - kC_2^n\right) - \mathrm{El}_e\left(C_1^t - kC_2^t\right)$$

Using Shepard's lemma and utilizing the homogeneity properties, it follows from (1) that: $C_{11}^t = -C_{12}^t w/c$ and $C_{22}^t = -C_{12}^t c/w$ (and similarly for n-sector). Using that, since $\gamma = c/w$, $\gamma = \mathrm{El}_e\,c - \mathrm{El}_e\,w$, $\mathrm{El}_e\,\phi$ can be written as

$$\mathrm{El}_e\,\phi = (A_t + A_n)\,\mathrm{El}_e\,\gamma > 0 \tag{7}$$

where

$$A_n = \frac{C_{12}^n x_n(w+kc)}{(L_n/L - K_n/K)K} \quad A_t = \frac{C_{12}^t x_t(w+kc)}{(L_n/L - K_n/K)K}$$

That is, shifting relative product prices in favour of t-sector shifts production towards t-sector.

By definition $C_{12}^n x_n = \sigma^n L_n K_n/(p_n x_n)$(and similar for t-sector), where σ is the elasticity of substitution (absolute value) in production. The As are thus increasing in the σs. It follows that the effect of changes in relative price, e, on the production structure, ϕ, is stronger the larger the elasticity of substitution in production.

Demand The total demand for final goods (both consumption and gross investment) is, for simplicity, assumed to be determined by the same homothetic preferences. This gives rise to a joint multiplicatively separable expenditure function

$$(1+\tau_n)p_n E^*\left(e\frac{(1+\tau_t)}{(1+\tau_n)}, X\right) \equiv (1+\tau_n)p_n E\left(e\frac{(1+\tau_t)}{(1+\tau_n)}\right)X$$

Here, X will be interpreted as an aggregated good being used both for consumption and investment. τ_n and τ_t are *ad valorem* tariff/subsidy rates on the two goods. The demand function and an explicit expression for the aggregate good is found using Shepard's lemma. The tariff wedge $(1+\tau_n)/(1+\tau_t)$ will, in the following, be labelled T. It is assumed that subsidies and tariffs nets to zero. Hence: $\tau_n p_n x_n + \tau_t p_t x_t = 0$.

For expositional clarity, the following discussion of trade reform will be held in the terms of a removal of tariffs. T has an alternative interpretation in the case of a trade regime with import quotas. Neary and Roberts(1980) show that without rent seeking or corruption, the allocation of goods realized by taxes can be equivalently realized by endogenous quotas. The following analysis is thus also valid for the, empirically relevant, removal of quotas. In that case T has the interpretation *notional* price of imports relative to the actual price of imports.

Given the expenditure structure above it follows that

$$\phi = \frac{E'}{E - E'e/T} \equiv D\left(e/T\right) \quad D' = -\varepsilon\phi T/e < 0 \tag{8}$$

$$X = X_n \frac{1}{E - E'e/T} \equiv X_n A\left(\phi\right) \quad A' > 0 \tag{9}$$

The sign of D' (and of the elasticity of substitution in demand ε) and A' follows from the concavity of the expenditure function. (9) shows that the aggregate good is a homogeneous function of X_n and X_t. Combining supply and demand and solving for the elasticities in general equilibrium gives

$$\hat{\phi} = \frac{\varepsilon}{\mathrm{El}_e\,\phi + \varepsilon}\left(\mathrm{El}_e\,\phi\hat{T} + \mathrm{El}_k\,\phi\hat{k}\right) \tag{10}$$

$$\hat{\gamma} = \frac{\mathrm{El}_e\,\gamma}{\mathrm{El}_e\,\phi + \varepsilon}\left(\varepsilon\hat{T} - \mathrm{El}_k\,\phi\hat{k}\right) \tag{11}$$

From the discussion above it follows that

$$\mathrm{El}_T\,\phi > 0,\ \mathrm{El}_\pi\,\phi > 0,\ \mathrm{El}_k\,\phi > 0,\ \mathrm{El}_T\,\gamma > 0\ \mathrm{El}_k\,\gamma < 0$$

Combining (9) with this general equilibrium gives the following overall production function with subscript indicating period

$$X_i = \underset{+}{x}(\underset{+}{k_i}, \underset{+}{L_i}, \underset{+}{T_i}) \tag{12}$$

Given that $T \leq 1$, the derivatives, indicated below the corresponding variables, follow directly from the homogeneity properties and the distortionary nature of the tariff wedge.

Effects on real factor prices Changes in T and k lead to changes both on γ, a substitution effect, and on X, a *level* effect, and have thus two effects on the real factor prices w and c.

Assuming that the aggregation function agrees with the standard neoclassical production function conditions, the net effect of increased k is increased w and reduced c. Further, with sufficiently different capital intensities between sectors, as T goes towards 1, the substitution effect will dominate and w will decrease and c will increase.

Under these conditions the wage and user cost equations are given by

$$w_i = \underset{+}{W}(k_i, \underset{-}{T_i}) \tag{13}$$

$$c_i = \underset{-}{C}(k_i, \underset{+}{T_i}) \tag{14}$$

with the signs of the derivatives essentially given by (11).

Consumption and accumulation The allocation of the composite product X_i satisfies, by definition, the following general budget

$$C_i = X_i - \Delta K_i - \delta K_i \tag{15}$$

The product is used for consumption, C_i, net capital formation, ΔK_i, and the replacement of depreciation, $\delta \cdot K_i$. The capital formation feeds in to next period's capital stock

$$K_{i+1} = K_i + \Delta K_i \tag{16}$$

All income, wage and interest, is earned by an infinitely lived representative consumer who maximizes his utility over all future periods under full certainty. The utility function is of the CRRA (constant relative risk aversion) type with θ as the subjective rate of time preference and σ as the intertemporal elasticity of substitution

$$V = \begin{cases} \sum_{i=1}^{\infty} \dfrac{\sigma}{(\sigma-1)(1+\theta)^{i-1}} C_i^{\frac{\sigma-1}{\sigma}} & \text{if } 0 < \sigma \neq 1 \\ \sum_{i=1}^{\infty} \dfrac{\ln(C_i)}{(1+\theta)^{i-1}} & \text{if } \sigma = 1 \end{cases} \qquad 0 \leq \theta \tag{17}$$

The model (12)-(15) and (17) is a standard decentralized version of the Ramsey model, modified to include the tariff wedge. The main results from this theory therefore applies.[7]

The optimal consumption path, following from the consumers's maximization of utility function (17) given budget (15), is

$$\frac{C_{i+1}}{C_i} = \left(\frac{1+r_i}{1+\theta}\right)^{\sigma} \tag{18}$$

where the interest rate r_i is the rental rate of capital, which added to the rate of depreciation defines the user cost of capital

$$c_{i+1} = r_i + \delta \tag{19}$$

The steady states First, to get hold of the long run effects of a removal of the tariff wedge, T, the implications for the steady state is evaluated.

In steady state there is no investment apart from the replacement of depreciation δK_i. Production and consumption are constant and all resources are fully utilized (given fully flexible factor prices, w and c, and constant labour supply). Stable consumption implies that $r = \theta = c - \delta$. Inserting in (12)-(14) and taking logarithmic derivatives (indicated by $\hat{}$) gives the following system

$$\hat{X} = X_T^e \hat{T} + X_k^e \hat{k}$$

$$\hat{w} = W_T^e \hat{T} + W_k^e \hat{k}$$

$$0 = C_T^e \hat{T} + C_k^e \hat{k}$$

where the superscript 'e' indicates elasticity. In a steady state the user cost of capital is fixed ($c = \theta + \delta$), so from the last equation it is seen that removing the tariff wedge (increase T) leads to increased k. This is a result of the increased competitiveness for the capital intensive $t-$sector.

[7] As seen for example in Takayama (1993).

Following from the first equation, both increased capital and removal of the tariff wedge (increased T) leads to higher production. The loss due to the tariff wedge is reduced at the same time as the capital stock increases.

The effect on the wage is ambiguous: there is reduced labour demand ($W_T^e < 0$) because of the reduced competitiveness of the labour intensive n-sector, but on the other hand the growth in the capital stock results in increased demand for labour ($W_k^e > 0$).

In any case, the model shows that 'Getting the prices right' improves efficiency trough reallocation of resources, and hence increases production and consumption in the long run. The next sections focus on the short run transition towards this new steady state.

3 The transition process

Consider first transitional dynamics in the case with totally flexible wages. The model is then a standard Ramsey model with a two-sector story behind the usual production function. In the section above, it was shown that the steady state, after removing tariffs, is a state with increased capital and production. Moving from the low capital steady state to the high capital steady state requires the building up of capital. This capital is mobilized through savings according to the consumption formula (18). Increased demand for capital leads to increased interest rates. Consumption will first drop and then increase gradually along a saddle path towards the new equilibrium as the capital stock increases and interest rate comes down. Along this path, t-sector grows relative to n-sector. $\gamma = c/w$ decreases as the wage increases and the user cost decreases. If the tariff wedge is removed (T set to one) instantaneously the instantaneous rise in the interest rate is big and the consumption path has a big dump. One example is shown as the 'Big Bang' path in Figure 1.

If the tariffs are removed gradually, the initial rise in the interest rate is smaller and the fall in consumption is less dramatic. The path to the new steady state is, in this case, more gentle. One possible gradualistic development is also illustrated in Figure 1. Note that both paths go towards the same new wedge-less steady state and that the unemployment is zero $U = 0$, throughout the adjustment process.

Figure 1: Dynamics following tariff reform

3.1 Gradualism and inflexible wages

When the possibility of inflexible wages is taken into account the model gets more complex.

In the following, in order to keep things simple and to clarify the main effects, a three period reform is considered, which is described in detail in Appendix A. The starting point is a historic steady state with a tariff wedge, $T < 1$. Then a tariff reform, aimed at resolving the inefficiency, is announced - the tariff wedge is going to be removed, instantly or gradually. The first period, (period 1) is the period in which the government announces this tariff reform program. The program can be one out of two:

- B*ig bang* The tariff wedge is removed totally in period 2.
- *Gradualism* The tariff wedge is removed totally in period 3 but only partially in period 2.

These alternative scenarios capture the main linkages between speed of adjustment, functional income distribution, and transition. In the present context, no essential elements

are lost by limiting the attention to the above alternatives.

The benchmark The first step in analysing the interplay between wage rigidity and gradualism is to characterize a benchmark within this three period setting. The benchmark is the friction free adjustment under big bang reform, as discussed above.

In the first period, when reforms are announced, capital is given by history and the production structure is thus given. Since the tariffs are yet to be changed, the product prices are also given. As soon as the reform program is announced, the t-sector gets an investment incentive. Since t-sector is the most capital intensive sector this leads to an over all increase in the demand for capital and therefore increased interest rate in period 1, r_1. Savings go up, consumption decreases, and the reduction of capital in n-sector starts.

In period 2 (the transition period) the tariff wedge is totally removed $T_2 = 1$. Now the build up of capital has brought the economy partly towards the new steady state. The demand for capital decreases and the interest rate goes somewhat down.

In period 3 there is no tariff wedge, $T_3 = 1$. This is the start of a smooth saddle path towards the new equilibrium. The path from period 3 is in every respect a friction free Ramsey-case.

In order to be able to discuss the effects of wage rigidity some simplifying assumptions are made[8] regarding the speed of adjustment in the benchmark.

- The wage in the second period is assumed to be lower than that in the previous period, $w_2 < w_1$.
- From period 3 the capital build up will induce a higher wage, $w_3 > w_2$.

[8]Interpreting the present model as a discrete approximation to a reality in continuous time, meeting these assumptions boils down to choosing an appropriate period length.

The assumptions and derived results are summarized up in Table 1.

Table 1. The transition periods in the benchmark

Period	1	2	3
	Reform announcement	Transition	Post transition
Tariff	$T_1 < 1$	$T_2 = 1$	$T_3 = 1$
Savings	$S_1 > 0$	$S_2 > 0$	$S_3 > 0$
Interest rate	$\theta < r_1$	$\theta < r_2 < r_1$	$\theta < r_3 < r_2 < r_1$
Wage	w_1	$w_2 < w_1$	$w_3 \geq w_2$

The effects of inflexible wages and gradualism, comparative statics. Compared with the benchmark, the effects of changes in two variables are considered.

1. Prolonging the presence of the tariff wedge into period 2 (T_2 down).

2. Unemployment in period 2 (L_2 down).

The effects of gradualism and unemployment are comprised in Table 2.

Table 2 Comparative statics. Effects of gradualism and unemployment.

Partial effect by	$T_2 \searrow$	$L_2 \searrow$ ($U_2 \nearrow$)
C_1	$+[-]$	$-(+)$
C_2	$-$	$-$
C_3	$-$	$-$
r_1	$-$	$-$
r_2	$+$	$+$
X_2	$-$	$-$
K_2	$-[+]$	$+(-)$
K_3	$-$	$-$
w_2	$+(-)$	$+$

Signs in ( ) indicate effect when the intertemporal elasticity of substitution, σ, is large.

Signs in [ ] indicate effect when σ is small, and the efficiency loss (given $T_2 < 1$) is large.

The static, partial, effects of a drop in T_2 as seen from (12)-(14) are clear: X_2 down, r_1 and c_2 down, and w_2 up. This, however, does not take in to account changes in the capital stock, K_2, following from the savings response.

The drop in X_2 has a positive effect on first period savings, while the drop in r_1 has a negative effect. The total effect on C_1 and K_2 is thus ambiguous. If the drop in X_2 is large (large efficiency effect) *and* the intertemporal elasticity of substitution is small (the effect of the drop in r_1 is weak) savings will increase (C_1 down and K_2 up). Otherwise K_2 will decline. If the drop in K_2 is large (σ large) this may overturn the initial positive impact from gradualism on w_2. In the following this possibility is ruled out.

This assumption of a moderate intertemporal elasticity of substitution is well in accordance with the following observation for developing countries: 'The evidence generally shows that interest rates and tax incentives have little or no effect on savings' (Schmidt-Hebbel et al. 1996)

For the rest of the variables the effects are clear. The first round drop in X_2 will not be entirely compensated even if K_2 increases, hence C_2 will go down. The drop in C_2 will not compensate the drop in X_2 so K_3 drops and r_2 rises.

The analysis of a change in employment is relevant for understanding the transitional causes of unemployment in the presence of inflexible wages. The immediate effects of reduced L_2 are reduced production, X_2, increased wage, w_2, and reduced interest rate r_1. As in the discussion of gradualism, the effects on savings are ambiguous. The first round positive effect on the wage, however, will not be altered. The negative income effect reduces consumption both in periods 2 and 3. K_3 goes down and r_2 goes up.

The welfare effects of gradualism The benchmark represents friction free utility maximization. Going to gradualism from this friction free case, by definition, leads to a loss in welfare for the representative consumer. As analysed above, gradualism may lead to higher consumption in the first period. This smoothing effect goes on the expense of lower post transition consumption. C_3 and K_3 unambiguously declines together with consumption in all the following periods. Gradualism in this case results in dynamic inefficiency, the consumers are forced to limit their saving and to pay for this by a weaker growth path. Wages rise during the transition process, but return on capital goes down.

Justification for gradualism in the presence of a minimum real wage The assumption about flexible wage is essential for the argument for big bang in favour of gradualism, given above. As discussed in the introduction, real wages may, for many reasons, be inflexible. If a minimum real wage prevents a wage drop consistent with market-clearing, there will be unemployment during transition.

The effect of a binding minimum wage can be read from Table 2. By assuming exogenous wages, the closure of the model is altered. The new endogenous variable is the unemployment. A wage above the market-clearing wage leads to a decline in employment. The effect of a minimum wage is thus found by increasing the unemployment ($U_2 = 1 - L_2$) from its friction free level 0. Increasing unemployment leads to reduced welfare both through reduced production, X_2, and through reduced capital stock in period 3.

The unemployment caused by inflexible wage can be reduced either by a reduced minimum wage or by an increased market-clearing wage. As seen above, gradualism can achieve the latter. A properly designed gradualistic programme will reduce the transitional unemployment in the presence of inflexible wages. This reduction of transitional unemployment is, in itself, a strong justification for gradualism.

Whether gradualism, in the strict sense, also will be welfare improving for the representative consumer depends on the total sum of efficiency gains and losses. On the plus side comes increased production caused by the increased employment. On the minus side comes the efficiency loss caused by the tariff wedge.

- With a binding minimum real wage, a gradualistic strategy will reduce transitional unemployment. It may also be welfare improving.

3.2 Numerical example

A numerical example is used to illustrate the discussion above. The following assumptions are made: (1) The production functions are Leontief with labour shares of 10/9 and 8/9 and capital shares of 2/3 and 4/3 for n and t-sector respectively. (2) The demand structure is characterized by equal and constant budget shares, implying $E(eT) = \sqrt{eT}$ and $X = 2\sqrt{X_n X_t}$. (3) Both the discount rate and the rate of depreciation are 1/8, i.e. $\theta = \delta = 1/8$. (4) The instantaneous utility function is logarithmic, i.e. the intertemporal elasticity of substitution, σ, is equal to 1. The values of depreciation, discounting, and

capital/output ratios are all consistent with a period length of about three years.[9] The starting point is the steady state with[10] $T = 1/3$.

Table 3 Assumptions made in numerical example.

Cost t-sector	$C^t(c,w) = \frac{4}{3}c + \frac{8}{9}w$
Cost n-sector	$C^n(c,w) = \frac{2}{3}c + \frac{10}{9}w$
Utility	$V = \sum_{i=1}^{\infty} \left(\frac{8}{9}\right)^{i-1} \ln(C_i)$
Demand	$E(eT) = \sqrt{eT}$
Parameters	$T_1 = 1/3$, $\delta = 1/8$

In the big bang scenario this tariff wedge is removed totally in period 2 and t-sector momentarily gets an edge. The consequences are seen in the left panel of Figure 1. Relative prices, e, shifts in t-sector's favour, wages drop by a heavy 43%, and at the same time the interest rate is bid substantially up. The capital stock in the n-sector drops and the capital stock in the t-sector rises. The total capital stock increases as the growth in the t-sector is stronger than the drop in the n-sector. The increased savings required for this net investment are mobilized via the increased interest rate.

In the periods following the transition period the economy is on the saddlepath towards the new steady state. C and w grow and r and e decline as the capital stock grows over time. As argued above, this development is by definition optimal. It is, however, dependent of a wage drop of 43%. This wage drop may be infeasible given a minimum real wage. If the real wage is downward inflexible the dynamics will be different.

In the minimum wage scenario, the real wage is not allowed to drop by more than 10%. A big bang removal of the tariff wedge will then lead to unemployment in the transition period. This scenario is shown in the middle panel of Figure 1.

The, now constrained, wage drop leads to transitionary unemployment of about 8%. This unemployment, as illustrated by the unemployment curve U, in turn reduces period 2 production and limits the increase in the interest rate. Savings in period 1 go down, reducing capital accumulation, and in turn reducing period 2 production even further.

[9] The choice of parameters and function forms has also been guided by the following three principles: (1) simplicity; (2) significant differences in labour/capital ratios between sectors; and (3) a sensible wage bill-GDP ratio in the steady states, both before and after the tariff reform. (Given the choice of parameters wage bill-GDP ratio is about 3/4)

[10] This implies an import tariff, $\tau_t = 100\%$ and a subsidy to non-traded goods of, $\tau_n = 33\%$.

The welfare drop associated with these consequences of wage stickiness is equivalent to a 4.2% drop in period 1 consumption.[11]

The implementation of a gradual tariff reform can prevent this unemployment and drop in welfare. By reducing T gradually from $T_1 = 0.33$ via $T_2 = 0.64$ to $T_3 = 1$, the dramatic shift of factor demand from labour to capital is reduced, and the full employment wage drops by only 10% to the transition period. This modest drop is feasible and, since wage stickiness does not set in, the transitional unemployment is avoided.

Compared to the frictionless big bang there is a slight welfare loss equivalent to 1.6% C_1 units. Compared to the big bang with binding minimum wage this represents a significant improvement. Thus, not only is the transitional unemployment avoided, but also 2/3 of the welfare loss associated with it. This gives a major argument for gradualism.

- Compared to the big bang, optimal gradualism prevents the transitional unemployment and compensates for about 2/3 of the welfare drop caused by inflexible wages.

4 Modifications and extensions

The model above was constructed combining two of the most influential neoclassical textbook models; the Ramsey model and the Heckscher-Ohlin model. The model thus enables the discussion of functional income distribution and transition within a familiar context, with a special emphasis on the interplay between sectoral allocation and the savings-investment dynamics. Building on these standard tools, this model represents one natural starting point for the analysis of transition within the neoclassical paradigm.

Having the characteristics of a benchmark model, it is naturally limited in many respects. Modifications and extensions can take several directions. A few interesting extensions are: the inclusion of various rigidities, technological progress, uncertainty, the possibility of increasing returns to scale, and the incorporation of political economy issues. The present work considers one possible rigidity by analysing the effects of a

[11] The equivalent variation argument goes as follows: The total utility is given by (17). With $\sigma = 1$ it follows that $\partial V/\partial C_1 = 1/C_1$. A welfare drop of ΔV is thus approximately equivalent to a relative change in C_1 of the same magnitude. $(\Delta C_1/C_1 \approx (\partial V/\partial C_1)^{-1}\Delta V/C_1 = \Delta V)$

minimum real wage. Without going in detail, I will discuss two other extensions, and their relevance for the present analysis.

Limits to factor movements Irreversible investments have been addressed in several works on growth theory, an early example is Arrow (1968). In the present context, departing from the assumption about frictionless movement of capital between sectors will have important consequences. In the numerical example, as illustrated in Figure 1, transfer of capital between sectors[12] is required both in the big bang and unemployment case. The results are achieved under the assumption that this transfer takes place without cost. Deviating from this assumption, i.e. including a cost, γ, associated with each unit of transferred capital (where $\gamma = 0$ is the costless case and $\gamma = 1$ represents absolutely irreversible investments), will have important implications for the analysis.

As γ increases, the shadow price of investment for the non-traded sector will decrease, reducing the disinvestment. As a result of the reduced transfer of capital, the price of capital facing the expanding traded sector will increase, delaying the transition process. The effect on the market-clearing wage can go either way. If the elasticity of substitution in production is small and the factor intensities are sufficiently diverse, the market-clearing wage will increase. Thus, the distance between the minimum and the market clearing wage will decrease, reducing unemployment in the minimum wage scenario. In that case, the cost of reversing investments work as an automatic stabilizer, reducing the need for a fine tuned gradualistic strategy.[13] This argument builds on the assumption about full certainty and perfect foresight. Adding uncertainty to the argument has additional important implications, as analysed for example in Dixit and Pindyck (1994).

Credibility and political economy Uncertainty, however, is not only relevant in conjunction with irreversibility of investment. Uncertainty related to the credibility of reform itself may seriously dampen the agents's response to the incentives generated by the reform. Several works are analysing political constraints to economic reform and the possibility of reversal. Important contributions are Blanchard et al. (1991) and Krueger (1993). Regarding speed of reform, arguments can be given in favour both of big bang and

[12] That is, in the early phase of transition, the reduction in non-traded sector's capital stock is larger than the rate of depreciation accounts for.

[13] With a choice of parameters as in the numerical example it can be shown that a cost γ indeed has this effect.

gradualism. If big bang removal of controls implies a total dismantling of the controlling agencies, the big bang reform may be the most credible. However, big bang reform may, as in the present model, hurt a part of the population to an extent that makes the big bang infeasible i.e. not credible.

As shown for example by Frooth (1988), Rodrik(1991), and Buffie(1995) an endogenization of the policy reversal can give rise to multiple equilibria and the possibility of self-fulfilling failure of reform. Their results are achieved in model quite different from the present. However, as explored in greater detail in Mehlum(1998), inclusion of political economy mechanisms in the present model can produce similar results.

In short the mechanism is as follows: given an announced reform, if private agents believe that the reform will be reversed in the future, they will not shift resources to the booming sector and the transitional wage drop will be strong. Combined with a political economy mechanism, where cancellation comes as a result of social unrest if the wage drop is to strong (e.g. if the wage falls below the legal minimum wage), multiple equilibria occurs. Thus, scepticism regarding credibility undermines the credibility itself. However, this vicious circle can be broken by making the programme more gradual. A sufficiently gradual programme will, even in the presence of expectations about reversal, give a market clearing wage during transition that is above the critical limit leading to reversal. Hence, expectations about reversal will not be consistent and a self-fulfilling failure is avoided.

In the present analysis, problems of multiple equilibria are avoided by assumption. However, the gradualistic programme that just goes clear of the minimum wage, may well lead to a self-fulfilling failure when political economy mechanisms are included. Using the terminology of Sachs et al. (1996), this programme will only be 'partially credible'. The programme will become "fully credible" if the degree of gradualism is sufficiently increased, i.e. if the speed of transition is further reduced.

5 Conclusion

This paper develops a dynamic two-sector model by combining the Heckscher-Ohlin model and the Ramsey model. This model is used to analyse the transitional dynamics following a tariff reform in an economy with inflexible real wages. It is shown that a binding minimum real wage leads to transitional unemployment and reduced welfare. This

transitory unemployment can be avoided in a gradualistic programme. In a numerical illustration, with a reasonable set of parameter values, it is further shown that gradualism compared to big bang gives a welfare improvement for the representative agent.

Welfare for the 'representative' agent aside, unemployment in itself should be of major concern. The political support for a tariff reform is surely dependent on to what extent limited groups must bear the bulk of the transitional burdens. Therefore, gradualism has a strong justification, through the reduction in transitory unemployment.

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A Three period comparative statics

The equations needed to get a complete account of the dynamic effect trade of reform are as follows:

Equation (18) determining the consumption dynamics:

$$\frac{C_2}{C_1} = \left(\frac{1+r_1}{1+\theta}\right)^{\sigma} \tag{20}$$

$$\frac{C_3}{C_2} = \left(\frac{1+r_2}{1+\theta}\right)^{\sigma} \tag{21}$$

Equation (12) determining the production:

$$X_1 = X(L_1, \frac{K_1}{L_1}, T_1) \tag{22}$$

$$X_2 = X(L_2, \frac{K_2}{L_2}, T_2) \tag{23}$$

Equation (19) and (14) determining the interest rate:

$$r_1 = c(\frac{K_2}{L_2}, T_2) - \delta \tag{24}$$

$$r_2 = c(K_3, 1) - \delta \tag{25}$$

Equation (13) determining the period 2 wage:

$$w_2 = w(\frac{K_2}{L_2}, T_2) \tag{26}$$

(17) and the Ramsey path determining period 3 consumption as a function of period 3 capital. The utility is determined by C_1, C_2, and the consumption path $C_3 \ldots C_\infty$ Being a saddle path solution, the path from $C_3 \ldots C_\infty$ is unique given K_3. The total utility given by (17) can thus be written as follows, with positive derivatives with respect to all

factors.

$$V = u(C_1, C_2, K_3) \tag{27}$$

with a corresponding period 3 consumption given by

$$C_3 = C_3(K_3) \tag{28}$$

Equation (15) determining the capital dynamics:

$$K_2 = X_1 - C_1 + \delta K_1 \tag{29}$$

$$K_3 = X_2 - C_2 + \delta K_2 \tag{30}$$

The 11 equations (20) to (30) list all the essential interplays between the three transition periods. The equations determine eleven endogenous variables: C_1, C_2, C_3, r_1, r_2, X_1, X_2, K_2, K_3, w_2, and V. The numeric values inserted in the functions reflects the benchmark where $L_1 = L_3 = T_3 = 1$. It should also be noted that in the benchmark $L_2 = T_2 = 1$.