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Abstract

The ability to engineer real wage cuts in centralized labor markets has depended on exchange rate interventions. This paper provides some structure to the question of how a monetary union would a¤ect the connection between bargaining structure and macroeconomic performance. The results indicate that the precautionary saving motive in anticipation of transitory terms of trade shock is signi…cantly reduced if an implicit contract is in place ensuring labor market clearing at all times. Thus, a pro-cyclical volatility is created in private consumption as well as real exchange rates. This hints that a monetary union membership, might endogenously change the real wage dynamics in centralized labor markets and the pending problem of cyclical unemployment in EMU currency area is therefore over-estimated.

JEL classi…cation: E21, J51, F33, F41

Keywords: Monetary Union, asymmetric shocks, terms of trade dynamics monetary policy, labor market ‡exibility, cyclical unemployment

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1. Introduction

The structure of the labor market has increasingly been perceived as a determinant of macroeconomic performance of a country. In seminal contribution, Calmfors and Dri¢ll (1988) argued that with regard to real wage ‡exibility, the two extremes of labor market bargaining worked best; either a fully decentralized bargaining system similar to Japan or the US or full centralization in line with the Scandinavian model. It is, however, important to note that the real wage ‡exibility acclaimed to the centralized model is usually not due to downward nominal wage ‡exibility. Real wage decreases are usually triggered by exchange rate depreciation following a negotiated standstill in nominal wages, with unions large enough to internalize the costs of both in‡ation and unemployment associated with their actions. Thus, it is not clear that the ‡exible nature of centralized bargaining process will be retained after the country in question has gained entrance into a monetary union with a larger currency area.

Absent the option to devalue in face of an asymmetric shock, the risk of cyclical unemployment has been considered as one of the key concerns in the discussion on the European Monetary Union. Several authors have addressed the question of whether an entrance into a monetary union will trigger labor reforms or not, (see e.g. Sibert and Sutherland 2000 or Calmfors 1998). This paper, however, attempts to tackle this question in a dynamic context in relation to terms of trade shocks. The aim is to provide more structure to the question of what consequences a policy regime shift, such as an entrance to a monetary union would have on the connection between centralization of bargaining structure and macroeconomic performance. The dynamics are captured with a simple perfect foresight model, describing a small open economy with a specialized export sector. Moreover, rather than investigating the policy performance in relation to a single shock in isolation, the time horizon is expanded to include a shock sequence which allows for a more realistic evaluation of the interaction between durability terms of trade shocks, a labor market bargaining, monetary policy and expectations of private agents in small open economies. The model is solved explicitly and then in turn calibrated.

The results that emerge, back the claim of Calmfors and Dri¢ll (1988) on the merits of centralized bargaining structure of the labor market in preventing cyclical unemployment, and how crucial the union cooperation is for the e¤ectiveness of monetary interventions in centralized labor markets. If the labor unions are not cooperative and resist real wage adjustments, a counter-cyclical monetary policy will create price instability and variability in the real exchange rate. An agreement with unions on a nominal wage freeze is therefore a condition for lowering the real wage and preserving employment without creating excess in‡ation. However, the e¤ects of such an agreement are more far reaching than is usually acknowledged. The simulations strongly hint that an implicit social contract aimed at preserving employment will reduce the incentive to save in anticipation of a temporary income shortfall. In fact, if degree of inter-temporal substitution is relatively high, the representative consumer will use the opportunity provided by a temporary high purchasing power during terms of trade booms to dissave and spend, even in excess of the windfall that is received. Thus, an excess procyclical volatility is created in private consumption.

The reason for this result is that private agents will, by virtue of perfect foresight, ponder the question of whether to save and accumulate monetary assets in anticipation of the temporary slump in purchasing power or to simply substitute consumption across time. Since the devaluation will signi…cantly reduce the real value of monetary assets, especially in terms of imported consumer goods, savings incentives are reversed. Signi…cant current account de…cits can be observed in the wake of a transitory and positive export shock. This suggests that actions that might seem as prudent, such as organized labor market cooperation to preserve employment, might actually have imprudent e¤ects on the spending and saving decisions of private agents. Moreover, a policy shift such as entrance into a monetary union, might endogenously change the real wage dynamics of in countries with central controlled labor markets and the pending problem of cyclical unemployment is therefore over-estimated.

The outline is as follows. Section 2 lays the model for a small open economy with the traits already mentioned. The short-term stabilization policy will be characterized as a set of instrumental rules, related to performance in the export sector, which aim to insulate the domestic economy from external shocks. This is only a formal presentation of a classical stabilization policy revolving around terms-of-trade changes and corrections for excess domestic cost increases. The labor market is characterized by downward nominal wage in‡exibility and is heavily unionized. Section 3 provides explicit solution paths, which are to be simulated in section 4 in response to both permanent and transitory terms of trade changes. The choice of parameters is generally consistent with the Scandinavian countries. Against this background we consider option of monetary autonomy with or without cooperation from the unions, against the case of a membership in a monetary union and lost monetary autonomy. Section 5 concludes with …nal remarks.

2. The Model

2.1. Prices and sectoral production

The model developed here, outlines a completely specialized small open economy that produces a non-tradable good Q_n and an export good Q_x: There is no import competing production and domestic consumption of the exported good is negligible and can be ignored. All tradable goods, Q_m; consumed within the economy are therefore imported. The economy is considered to be a price taker, the foreign price of imports P_m^* is assumed to be constant but the foreign price of exports P_x^* is subject to random changes. The domestic price of the imported good P_m is given by the exchange rate, e, since units have been chosen so the fixed world market price equals unity. The general price level of the economy P is constructed as a geometric average of the imported tradable and non-tradable good prices. The respective consumption shares are γ_n and γ_m:

$$P_x = eP_x^*; \tag{2.1}$$

$$P_m = e; \tag{2.2}$$

$$P = P_n^{\gamma_n} e^{\gamma_m}; \quad \gamma_n + \gamma_m = 1 \tag{2.3}$$

Production in each sector requires capital K_i and labor L_i; $i = x; n$. Given the short time-span under consideration, firms in the non-tradable sector are only free to vary their labor input. Capital stock is taken to be fixed and sector specific. Both sectors tap into the same labor pool and the same market wage w therefore applies. Both production technologies $F^i(\cdot)$ are continuous and strictly quasi concave and the firms in each sector operate in a competitive environment. Output in the export sector is dependent on a fixed natural resource and more inputs will not expand production further than the given limit. Therefore, the use of inputs in export sector is fixed and output is constant. The usual labor market clearing conditions apply to the non-tradable sector, while the non-tradables markets clears when,

$$D_n(e; P_n; E) = Q_n: \tag{2.4}$$

2.2. Wage adjustment

In the long run wages are determined by changes in the price index and the natural rate of unemployment prevails and the long-run total labor supply, $\bar{l}$[1], is normalized at unity. However, it assumed that the adjustment process is delayed in the short-run, during which time the unemployment rate might deviate from the natural rate. We can characterize the adjustment process as,

$$\frac{\dot{w}}{w} = \frac{\dot{P}}{P} + g(l_x + l_n - 1); \tag{2.5}$$

where l_x and l_n are the respective shares of the labor force employed by each sector and the parameter g determines the responsiveness of the nominal wage to the unemployment rate,. Expression (2.5) can also be written in terms of the real wage,

$$\frac{\dot{\omega}}{\omega} = g(l_x + l_n - 1); \tag{2.6}$$

where $\omega = \frac{w}{P}$: Since the nominal wage w is predetermined, the real wage jumps instantly with the price level when a shock occurs. However, with the possibility of open unemployment, production in the non-tradable sector can vary as the result of a delayed wage adjustment. It is furthermore assumed that the unemployment rate can for a short-time dip below the natural level and the total labor supplied can be in excess of unity for short periods of time, e.g. through increases in hours worked by currently employed workers.

The firms in each sector operate under perfect competition. Labor demand in the non-tradable sector can therefore be derived from the first order conditions resulting from profit maximization,

$$\hat{l}_n = -\eta_n \left(\hat{\omega} + \gamma_m(\hat{e} - \hat{P}_n) \right); \tag{2.7}$$

where η_n is the wage elasticity of labor demand in the non-tradable sector ($\eta_n = -\frac{dl_n}{dw}\frac{w}{l_n} > 0$).

2.3. The private sector optimization problem

Decisions about consumption and savings are made by a representative agent who has homothetic preferences and maximizes utility over an infinite lifetime by choosing between spending E and saving S. Money is the only financial asset in the economy and the capital account is closed. The non-pecuniary services rendered by real money balances, such as the facilitation of transactions etc., are accounted for in the $\chi(\cdot)$ component of the utility function. This separable form allows us to substitute an indirect utility function into the maximization problem to represent the utility derived from consumption. The indirect utility function has the usual properties, i.e. $\frac{\partial V}{\partial P_i} < 0$; $\frac{\partial V}{\partial E} > 0$ and $V_{EE} < 0$.

$$\underset{\{E;S\}}{Max} \int \left[V(e; P_n; E) + \phi\left(\frac{M}{P}\right) \right] e^{-\rho t} dt \tag{2.8}$$

subject to,

$$E = P_x Q_x + P_n Q_n - S; \tag{2.9}$$

$$\dot{M} = S; \tag{2.10}$$

where ρ is the fixed time preference rate and an overdot denotes a time derivative.. (2.10) states that all saving is channeled into the accumulation of money, the only available store of wealth.

2.4. Monetary policy

The sole source of disturbance in this economy is price volatility in the export sector and the only transmission channel for monetary interventions is through exchange rate interventions. We will attempt to formalize the monetary policies in small export based economies in terms of a simple instrumental rule focusing on profitability in the export sector. Since the business environment is competitive total revenue must be equal to total cost in the export sector,

$$P_x \bar{Q}_x = w\bar{L}_x + r_x \bar{K}_x: \tag{2.11}$$

The rent from the fixed capital stock essentially captures economic profit in the sector and the government must therefore keep r_x constant in order to achieve profit stability. Given this we can log differentiate (2.11) and with a little re-arrangement the following equilibrium relationship is obtained:

$$\hat{P}_x = \theta_L^x \hat{w}: \tag{2.12}$$

The term $\theta_L^x = \frac{wL_x}{Q_x}$ is the cost share of labor in the export sector and for notational ease, a hat superscript denotes a percentage change, i.e. $\hat{x} = \frac{dx}{x}$: If we now log differentiate the domestic export price as represented in equation (2.1) and then insert into the above expression (2.12) we obtain the following reaction function,

$$\hat{e} = \theta_L^x \hat{w} - \hat{P}_x^*: \tag{2.13}$$

This instrumental rule above displays similar characteristics as one would expect from stabilization policy according to standard economic theory. Negative terms of trade shocks trigger devaluation, as will excess increases in domestic production cost (in this case only wages). Positive developments on the other hand will lead to appreciations. It is worth noting that it is nominal, not real profit that is being targeted, which implies that the government does not respond to inflation directly, unless higher prices prompt increases in the nominal wages.

We wish to evaluate the outcome of the exchange rate rule by comparing it to the case of non-intervention and therefore we will write equation (2.13) as,

$$\hat{e} = Z\left(\theta_L^x \hat{w} - \hat{P}_x^*\right); \qquad (2.14)$$

where Z is a policy parameter which takes the value 0 in the case of the non-interventionist case (i.e. when e is fixed). and is equal to 1 when the exchange rate rule is in place.

2.5. Labor demand

Given the short time-span under consideration, firms in the non-tradable sector are only free to vary their labor input. The first order condition resulting fro

Therefore eq. (2.7) can be rewritten as,

$$\hat{l}_n = -\eta_n\left(\hat{\omega} + \gamma_m Z(\theta_L^x \hat{w} - \hat{P}_x^*) - \gamma_m \hat{P}_n\right). \qquad (2.15)$$

Note that $\hat{\omega} = \hat{w} - \hat{P}$; the change in the nominal wage can therefore be expressed as

$$\hat{w} = \frac{\hat{\omega} + \gamma_n \hat{P}_n - \gamma_m Z \hat{P}_x^*}{1 - \gamma_m Z \theta_L^x}. \qquad (2.16)$$

Substituting this into (2.15) and collecting terms gives,

$$\hat{l}_n = \frac{-\eta_n}{1 - \gamma_m Z \theta_L^x}\left(\hat{\omega} - (1 - Z\theta_L^x)\gamma_m \hat{P}_n - \gamma_m Z \hat{P}_x^*\right). \qquad (2.17)$$

A higher real wage will, as expected, decrease labor demand in the non-tradable sector and higher price of non-tradables will do the opposite. What is less obvious is that a higher export price will, through exchange rate intervention, directly increase demand for labor in the non-tradable sector. Although, of course, the total effect on labor demands depends on how P_x^* will affects P_n and ω. In other words, the effect of the nominal exchange rate on labor demand is now an additional transmission mechanism for monetary interventions in this model.

2.6. Prices

To solve for the equilibrium prices in this economy, combine the market clearing constraint

$$-(\varepsilon+\gamma_n)\hat{P}_n + (\varepsilon-\gamma_m)\hat{e} + \hat{E} = \hat{Q}_n; \tag{2.18}$$

The supply response in the non-tradable sector

$$\hat{Q}_n = \theta_L^n \hat{l}_n = -\frac{\theta_L^n \kappa_n}{1-\gamma_m Z \theta_L^n}\left[\hat{\varpi} - [1-\gamma_m Z\theta_L^x]\gamma_n \hat{P}_n\right] \tag{2.19}$$

the budget constraint

$$\hat{E} = \alpha_x(\hat{e} + \hat{P}_x^*) + \gamma_n \hat{P}_n + \gamma_n \hat{Q}_n - \frac{dS}{E}; \tag{2.20}$$

and the policy rule for exchange rate

$$\hat{e} = Z\left[\frac{\theta_L^x\left(\hat{\varpi} + \gamma_n \hat{P}_n\right) - \hat{P}_x^*}{[1-\gamma_m Z\theta_L^x]}\right]. \tag{2.21}$$

This yields the following solution for $\hat{P}_n$ and $\hat{e}$:

$$\begin{aligned}\hat{P}_n = {} & \Phi^{-1}\left[[\theta_L^x Z(\varepsilon+\alpha_x-\gamma_m) + \theta_L^n\kappa_n\gamma_m]\hat{\varpi} - (1-\gamma_m Z\theta_L^x)\frac{dS}{E}\right] \\ & + \Phi^{-1}[(\gamma_m - \alpha_x - \varepsilon)Z + \alpha_x[1-\gamma_m Z\theta_L^x] - \kappa_n\theta_L^n\gamma_m\gamma_m Z]\hat{P}_x^*;\end{aligned} \tag{2.22}$$

$$\hat{e} = Z\Phi^{-1}\left[[\varepsilon + \theta_L^n\kappa_n\gamma_m]\theta_L^x\hat{\varpi} - \gamma_n\theta_L^x\frac{dS}{E} + [\alpha_x\theta_L^x\gamma_n - \gamma_m\kappa_n\theta_L^n\gamma_m - \varepsilon]\hat{P}_x^*\right]. \tag{2.23}$$

where,

$$\Phi = [(\varepsilon + \gamma_m\kappa_n\theta_L^n\gamma_m)(1 - Z\theta_L^x) - (\alpha_x - \gamma_m)Z\theta_L^x\gamma_n]$$

The results are somewhat predictable. A higher real wage will, other things constant, raise the price of non-tradables as well as trigger devaluation to compensate the export sector for higher labor costs. However, the direct effect of an export price change on $\hat{P}_n$ is ambiguous since there is a conflict between income effect directly leading from $\hat{P}_x^*$ and substitution between tradables and non-tradables which the resulting exchange rate adjustment brings about.

3. Solving the model

3.1. General solution

For which the following Hamiltonian function is specified,

$$H = e^{-\rho t}\left[V(e; P_n; P_x Q_x + P_n Q_n - S) + \phi(\frac{M}{P}) - \mu \dot{S}\right]; \tag{3.1}$$

where μ is the Lagrangian multiplier associated with the optimization. The first order conditions are,

$$V_E = \mu; \tag{3.2}$$

$$\dot{\mu} = \rho\mu + \phi'(\frac{M}{P})\frac{1}{P}. \tag{3.3}$$

As before Q_x can be treated as a constant, and time differentiation. If we assume unitary income elasticities of demand and for small changes in the neighborhood of the steady equilibrium, $\alpha_x = \gamma_m$; then with a little rearrangement and linearization around the initial stationary equilibrium. (Note that $\dot{\varpi} = \varpi g dl_n$) . Thus, we will obtain a three dimensional simultaneous dynamic system.

$$\begin{bmatrix} \dot{S} \\ \dot{\varpi} \\ \dot{M} \end{bmatrix} = \begin{bmatrix} C_1 & C_2 & C_3 \\ C_4 & C_5 & 0 \\ 1 & 0 & 0 \end{bmatrix} \begin{bmatrix} S \\ \varpi - \varpi^* \\ M - M^* \end{bmatrix}. \tag{3.4}$$

Where,

$$C_1 = \frac{1}{B}\left[\rho[(\varepsilon + \gamma_m \kappa_n \theta_L^n)(1 - Z\theta_L^x) + \gamma_n] - \frac{\varepsilon\gamma_m \kappa_n l_n g A}{\varepsilon + \kappa_n \gamma_m \theta_L^n \gamma_m}\right]$$

$$C_2 = \frac{1}{B}\left[[(Z\gamma_n + 1)\varepsilon + \gamma_m\gamma_m]Z\theta_L^x - \gamma_n(\varepsilon - \gamma_m) - \frac{A\varepsilon l_n g}{\theta_L^n(\varepsilon + \kappa_n\gamma_m\theta_L^n\gamma_m)}\right]\frac{\kappa_n l_n}{\gamma_n}$$

$$C_3 = \frac{1}{B}[(\varepsilon + \kappa_n\gamma_m\theta_L^n\gamma_m)(1 - Z\theta_L^x)]\frac{\rho}{\chi}$$

$$C_4 = \frac{-g\kappa_n\gamma_m\theta_L^n\gamma_n}{(\varepsilon + \kappa_n\gamma_m\theta_L^n\gamma_m)}$$

$$C_5 = \frac{-\varepsilon g\kappa_n l_n}{(\varepsilon + \kappa_n\gamma_m\theta_L^n\gamma_m)}$$

The general solution to (3.4) can be written as follows.

$$\begin{bmatrix} S \\ \varpi - \varpi^{*} \\ M - M^{*} \end{bmatrix} = \begin{bmatrix} Z_{11} & Z_{12} & Z_{13} \\ Z_{21} & Z_{22} & Z_{23} \\ Z_{31} & Z_{32} & Z_{33} \end{bmatrix} \begin{bmatrix} k_1 e^{\lambda_1 t} \\ k_2 e^{\lambda_2 t} \\ k_3 e^{\lambda_3 t} \end{bmatrix}, \quad \begin{array}{l} i = 1; 2; 3 \\ j = 1; 2; 3 \end{array} \tag{3.5}$$

where Z_{ij} are the eigenvectors, λ_i the eigenvalues associated with the solution and k_i are constants determined by the initial conditions. The nominal wage is predetermined, but the real wage can jump instantaneously through the exchange rate or price adjustment. Thus, of the three variables in question, only M is a state variable, and both S and ϖ are jump variables. For the system to be saddlepoint stable, two eigenvalues have to be positive, one negative.

3.2. Solution paths: Permanent and unexpected shocks

If the dynamic system is hit by a permanent export price shock, then the economy will traverse the unique saddlepath leading to the new equilibrium; on which the constants associated with the positive eigenvalues are zero, (i.e. $k_2 = k_3 = 0$): Therefore we can write the solution for all three variables in terms of just one unknown constant k_1:

$$S(t) = \lambda_1 k_1 e^{\lambda_1 t}. \tag{3.6}$$

$$\varpi(t) - \varpi^{*} = k_1 \frac{\lambda_1 C_4}{(\lambda_1 - C_5)} e^{\lambda_1 t}. \tag{3.7}$$

$$M(t) - M^{*} = k_1 e^{\lambda_1 t}. \tag{3.8}$$

The additional information needed to solve for the unknown constant can be obtained from initial conditions, which relate the change in steady state money holdings to k_1. At $t = 0$; (3.8) yields,

$$M_0 - M^{*} = k_1. \tag{3.9}$$

Since we have assumed that income elasticity of money demand is unitary, the change in steady state expenditure and money balances must be directly related, i.e. $\hat{E}_{ss} = \hat{M}_{ss}. \Rightarrow M^{*} - M^{0} = M_0 \hat{E}_{ss}$. The delayed wage adjustment only affects the transitional path and not production in the long run. Thus the change in steady state money holdings remains unchanged from the earlier case of perfect price adjustment. The constant k_1 can therefore be expressed as,

$$k_1 = -(M^{*} - M^{0}) = -M_0 \ast \hat{P}_x^{*}. \tag{3.10}$$

$$\Lambda = \frac{[Z\theta_L^x \gamma_m + \gamma_n][\gamma_m - Z\varepsilon] + (1 - Z)\gamma_m \varepsilon (1 - Z\theta_L^x)}{\varepsilon(1 - Z\theta_L^x)}$$

The solution paths for S, ϖ and M can now be written,

$$S(t) = -\lambda_1 M_0 \Lambda \hat{P}_x^* e^{\lambda_1 t}, \tag{3.11}$$

$$\varpi(t) - \varpi_0 = -\lambda_1 \frac{M_0 \Lambda_1 C_4}{(\lambda_1 - C_5)} \hat{P}_x^* e^{\lambda_1 t} + \varpi_0 \left(\frac{\varpi^* - \varpi_0}{\varpi_0} \right). \tag{3.12}$$

$$M(t) - M_0 = M^0 \Lambda (1 - e^{\lambda_1 t}) \hat{P}_x^*. \tag{3.13}$$

Since there is no change in labor input across stationary equilibrium, it is clear that,

$$\hat{l}_n = -\kappa_n \left(\hat{\varpi} + \hat{P} - \hat{P}_n \right) = 0,$$

That is, in the long-run $\hat{w} = \hat{P}_n$, and the permanent change in the real wage depends on the relative movements of the CPI and P_n as the result of an export price change,

$$\hat{\varpi} = \hat{P}_n - \hat{P} = \gamma_m (\hat{P}_n - \hat{e}). \tag{3.14}$$

Thus, by using the long-run versions of equations (2.22) and (2.23),

$$\frac{\varpi^* - \varpi_0}{\varpi_0} = \frac{\gamma_m \gamma_m}{\varepsilon} \hat{P}_x^*. \tag{3.15}$$

Given that we can express eq. (3.12) as,

$$\varpi(t) - \varpi_0 = \left(\frac{\gamma_m^2}{\varepsilon} \varpi_0 - \lambda_1 \frac{M_0 \Lambda_1 C_4}{(\lambda_1 - C_5)} e^{\lambda_1 t} \right) \hat{P}_x^*. \tag{3.16}$$

3.3. Solution paths: Temporary and anticipated shocks

In order to factor in the effects of transitory shocks and expectations, we will now increase the number of shocks. The initial shock comes as a surprise, but is now followed by two subsequent shocks that are known with certainty. More specifically, the sequence of shocks is as follows: In the beginning, at $t = 0$, there is a 10% export price increase; then three years later at $t = t_1 = 3$ the price falls 20% and lastly six years down the road at $t = t_2 = 6$, the export price returns to its initial level by rising 10% increase. In other words, the shocks are temporary and the economy follows a full cycle returning to the initial supply conditions with the last shock.

The anticipated shocks raise the issue of how the trade unions will value full employment versus purchasing power stability, and thus how they will react to the devaluation at t_1 that is known beforehand. Unless there are some binding long term contracts that limit nominal wage increases, the possibility exists that the unions will instantly offset a devaluation with nominal wage demands. In other words, the questions hinges on whether the union will allow the real wage to jump downward when the shock occurs. That decision might depend on the labor market conditions at the time the shock occurs, e.g. a tight market where excess demand is observed rather than excess supply may translate into inflexibility and vice versa. Moreover, the overall structure of wage bargaining has to be a factor. If the unions are centralized into one bargaining team, they are more willing to acknowledge the need for a lower real wage in order to preserve employment.

In the simulations we will allow for the these two possibilities. If the labor unions are cooperative in the sense they allow the real wage to fall in the event of a devaluation, the nominal wage is pre-determined as the shock occurs and the real wage is a jump variable. By second choice, if the unions are not willing to accept the sharp decrease in purchasing introduced by a devaluation, then the nominal wage is not predetermined and the real wage will not jump. This distinction is crucial for the outcome, as it turns out. The transitional paths and their explicit solutions are described in appendix A.

4. Simulations

4.1. The choice of parameters

The choice of parameters is in line with Scandinavian countries, concerning openness (γ_m) and the ratio of High-powered money over expenditure ($\frac{M}{E}$) . The estimates concerning intertemporal substitution are taken from Herbertsson (2001). These parameters may vary from country to country. Ogaki & Reinhart (1998) estimate, by taking durable goods into account, that the inter-temporal substitution in the US is in the range $0.32 - 0.45$. Others have produced similar or slightly higher estimates, see e.g. Hu (1993) for estimates for G-7 countries. By focusing specifically on import consumption in the US Ceglowski (1988) finds estimates of τ that are close to one. Therefore in this paper we let τ vary in the range $0.25 - 0.8$. The division of consumption into tradable and non-tradable goods is also somewhat artificial since most final goods are composites. In general, compensated demand elasticities for broadly aggregated goods cannot be expected to be very large. However, in the literature, values ranging from 0.10 and up to 0.7 have been reported for broadly aggregated compensated demand elasticities (See for example Deaton & Muellbauer (1980) or a survey by Blundell (1988)) In light of this we feel justified to let the value of ε range from $0.15 - 0.75$. The degree of wage stickiness is more difficult to assess. However, since there are three years between the shocks in the policy experiments, the values chosen for g will create an adjustment (0.25-0.5) process which is roughly three years for cyclical unemployment to be almost eliminated..

Parameter	Notation	Value
Consumption share; imported goods	γ_m	40%
Consumption share; non-tradable goods	γ_n	60%
Labor cost ratio in the export sector	θ_L^x	40%
Labor cost ratio in the non-tradable sector	θ_L^n	75%
The ratio of highpowered money to E	$\frac{M}{E}$	15%
Time preference rate	ρ	7%
The elasticity of intertemporal substitution	τ	0.1-0.8
Cross price elasticity	ε	0.15-0.75
Wage elasticity of labor demand in the non-tradable sector	η_n	1.5
The degree of wage stickiness	g	0.25-0.5
The share of the labor force employed in the non-tradable sector	l_n	85%

4.2. Numerical solutions: Permanent shocks

Broadly stated, the simulations reveal that the application of the exchange rate rule delivers results which are qualitatively different from that of monetary union, almost regardless of parameter values, and confirm the benefits of monetary autonomy as it has usually presented in most textbooks. When the economy is hit with a 10% permanent, unexpected and negative shock, an exchange rate intervention will lead to a trade surplus as opposed a deficit (see figure 1B), a burst of inflation instead of deflation (see figure 1F) and an immediate decrease in the real wage (see figure 1C) compared with increase which would occur in the case of a monetary union. Thus, unemployment is averted (…gure 1D) or at least signi…-cantly decreased. As would be expected the force of the cross price substitution between tradables and non-tradables will be a determining factor for the e¤ect of the exchange rate intervention. If " is rather high, demand for labor will increase in the aftermath of the devaluation and signi…cant in‡ation will result. Policy makers who are not extremely averse to in‡ation would be inclined to favor the exchange rate policy to laissez faire, since e.g. when " = 0:45 and ¿ = 0:45; an exchange rate intervention would deliver 4% in‡ation and no unemployment compared with 4% cyclical unemployment and 2% de‡ation under non-intervention. The bargaining structure is not an issue here since the shock and the intervention comes as a surprise, and the real economy is almost instantly guided to a new equilibrium.

4.3. Numerical solutions: Transitory shocks

4.3.1. Savings

When the shocks are temporary and anticipated, then the fundamentals are less importance than in the permanent case when the new, …nal equilibrium was an immediate fast. Policy and private sector expectations have therefore a much greater in‡uence over spending and savings decision, e.g. as to how temporary windfall should be used. This becomes very visible if we compare the case of a monetary union with monetary autonomy. Absent the option to devalue, the specter of future unemployment and income losses will increase the incentives to save during the three good years preceding the three bad years in order to smooth consumption. Thus we observe annual trade surpluses which amount to 3 ¡ 6% of total GDP until the negative shock occurs at t = 3 and signi…cant de…cits appear, as can e.g. be seen in …gures 2-7B. This is line with the presumed current account movements consistent with consumption smoothing. Therefore it is surprising how much the current account is a¤ected by the interplay between actions in the labor market and monetary interventions. If the unions cooperate, then the general incentive to save in anticipation of a negative shock is decreased and relatively large current account de…cits my appear. This result can be traced to the fact that the real wage will jump downwards when the negative shock hits at t = 3; due to currency depreciation and predetermined nominal wage. However, the low level of purchasing power is short-lived and the real wage will rise relatively fast in the subsequent periods (see e.g. …gure 20b). For the representative agent, the question is whether to save and accumulate cash balances in anticipation of the temporary slump in purchasing power or to simply substitute consumption across time. If the degree of inter-temporal substitution is high, the consumers will be less inclined to accumulate monetary assets, in the periods prior to the shocks to sustain consumption over the sharp drop in the real wage. As the result, signi…cant trade de…cits appear in the …rst three years. The pro-cyclical tendency of the current account is much less pronounced when the unions are not cooperative. This is a remarkable, as it suggests that actions that might seem as prudent, such as organized labor market cooperation to prevent nominal wage increases, might actually have imprudent e¤ects on the spending and saving decisions of private agents.

4.3.2. Prices

Prices are generally more stable in a monetary union, assuming that the price level is stable in the currency area as whole. In‡ation never ventures above 10% (9% being the maximum, see …gure 7F)and for most cases not higher than 5%. The exchange rate policy is more in‡ationary, although the policy authorities are able to dampen the in‡ationary e¤ects of currency depreciation by negotiating a nominal wage freeze. Conversely, when cooperation is lacking, considerably more in‡ation is observed, partly because larger nominal exchange rate adjustments are needed to reach the stated policy goals and partly because domestic prices are not anchored down in the same manner as was the case with full union co-operation (see e.g. …gure 3F). Generally stated, about 20% nominal depreciation and10% in‡ation results when the negative shock occurs at t = 3 when the unions are cooperative, compared with 30% depreciation and 20% in‡ation when the cooperation is lacking.

4.3.3. Unemployment and wages

The need for an economy wide adjustment should be less pronounced when the shocks are transitory and anticipated, than would be the case if people are caught by surprise and are unable to save in advance to meet the temporary income shortfall. This evident from the multiple shock simulations. They reveal that a 20% transitory export price decrease at t = 3 results in 2 ¡ 3% unemployment if " ¸ 0:25 which is a signi…cantly lower rate than was earlier observed for 10% permanent price decrease (see …gure 1f). In other words, the proposed bene…t from an exchange rate adjustment in terms of preventing excess supply is less apparent when the shocks are temporary.

The exchange rate policy is unsuccessful in lowering the real wage if it is not supported by labor market agreement on halted nominal pay increases. In other words, since the unions foresee the currency alignment they will neutralize it with instant nominal wage increases as the devaluation occurs. The resulting change in the exchange rate will be larger (see …gures 4A-5A) and the shock is felt more as a shift in the relative price of tradables versus non-tradables and less as an income shock. As the result, there is a greater substitution away from non-tradables and into tradables, possibly with some increase in unemployment during the three …rst periods leading up to the shock (see …gure 4D). This is subsequently reversed after t = 3 and the increased demand for non-tradables after the devaluation is su¢cient to sustain a labor market clearing with an almost unchanged real wage.On the other hand If the unions accept a nominal wage freeze, the real wage will drop sharply and the shock is felt mainly as a decrease in overall purchasing power.

5. Conclusion

If the conventional assumptions hold; the shocks are permanent and the exchange rate interventions are unanticipated, then familiar things appear with the incorporation of nominal wage constraints to the model. The monetary authorities are able with interventions built on that premise to stabilize the labor market and the current account, without excessive in‡ationary consequences. When the shocks become multiple and anticipated, this picture is changed. The shocks do not a¤ect employment as much because of their transitory nature. On the other hand, interventions in this shifting environment bring with them considerable side e¤ects, which are highly dependent on the labor market structure. If the labor unions are not cooperative, they will demand instant nominal wage increases in response to anticipated exchange rate interventions, which e¤ectively prevent the real wage from falling. In that case the labor market does clear in the event of a negative shock, but only after a massive devaluation, price increases and huge shift in the relative price of tradables versus non-tradables. An agreement with unions on a nominal wage freeze is the key to lowering the real wage and prevent excess in‡ation.

The agents will expect a short-lived but a large fall in the real wage towards the end of every economic upturn and they will use the temporary high purchasing power to stock up on imported goods to sustain consumption during the brief period of low purchasing power. As the result, savings incentives are reversed and signi…cant current account de…cits are observed in the wake of a positive export shock. Moreover, the application of this exchange rate policy combined with minimal nominal wage increases facilitates a drop in real wage that goes far below what is needed in order to clear the labor market and a considerable excess demand is observed.

On the other hand, the interruptions caused by asymmetric terms of trade shocks to aggregate demand are considerably dampened by an irrevocably …xed exchange rate since the precautionary savings-motive for smoothing consumption is signi…cantly strengthened. Of course, cyclical unemployment is more likely to surface when exchange rate interventions are no longer possible, but the magnitude are of a far lesser scale after the monetary union is a fact than would be assumed judging from pre-membership need for real adjustment.

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7. Transitional paths

The transitional period can be divided into three distinct time periods, each marked by di¤erent constants, k, determined by the three shocks.

The first path The first shock occurs in the beginning at t_0. Since it is not permanent and lasts only until t_1; the economy is not constrained to follow a convergent path to a new saddle point equilibrium. Instead, dynamic optimization will imply a non-convergent path that may be qualitatively different from a permanent price change, since the temporary price shock will not imply a fixed end point that pins down the equilibrium path. This initial shock is unexpected and therefore there will be a jump in both the savings rate and real wage because the nominal wage is pre-determined due to the surprise. The following equations characterize the period from t_0 to t_1. Since the path is non-convergent the two constants associated with the positive eigenvalues cannot be assumed to be zero,

$$S_t = \lambda_1 k_1 e^{\lambda_1 t} + \lambda_2 k_2 e^{\lambda_2 t} + \lambda_3 k_3 e^{\lambda_3 t}; \tag{7.1}$$

$$\omega_t - \omega_0 = \omega^* - \omega_0 + C_4 \left[\frac{\lambda_1 k_1}{\lambda_1 - C_5} e^{\lambda_1 t} + \frac{\lambda_2 k_2}{\lambda_2 - C_5} e^{\lambda_2 t} + \frac{\lambda_3 k_3}{\lambda_3 - C_5} e^{\lambda_3 t} \right]; \tag{7.2}$$

$$M_t - M_0 = M^* - M_0 + k_1 e^{\lambda_1 t} + k_2 e^{\lambda_2 t} + k_3 e^{\lambda_3 t}: \tag{7.3}$$

where the star notation acknowledges the new stationary equilibrium implied by the respective export price change as if it would be permanent.

The second path The second shock occurs at t_1 and is also temporary. There will be a shift as the economy links to another path and since the money stock is pre-determined the change occurs with a jump in the savings rate and possibly the real wage at t_1; depending on the unions' response to the anticipated devaluation. The new path is not convergent either since the third price change is expected at t_2 and utility maximization does not imply adjustment to a permanent end point. We can characterize this period in the same way as before except for the fact that the constants have changed, none which can be assumed to be zero;

$$S_t = \lambda_1 k_4 e^{\lambda_1 t} + \lambda_2 k_5 e^{\lambda_2 t} + \lambda_3 k_6 e^{\lambda_3 t} \tag{7.4}$$

$$\omega_t - \omega_0 = \omega^{**} - \omega_0 + C_4 \left[\frac{\lambda_1 k_4}{\lambda_1 - C_5} e^{\lambda_1 t} + \frac{\lambda_2 k_5}{\lambda_2 - C_5} e^{\lambda_2 t} + \frac{\lambda_3 k_6}{\lambda_3 - C_5} e^{\lambda_3 t} \right] \tag{7.5}$$

$$M_t - M^0 = M^{**} - M_0 + k_4 e^{\lambda_1 t} + k_5 e^{\lambda_2 t} + k_6 e^{\lambda_3 t} \tag{7.6}$$

$$t_1 \leq t \leq t_2$$

If we denote M^{**} and ω^{**} as being the new steady state associated with the negative export price shock at t_1; and since $\hat{P}_x^*(t_0) = -2\hat{P}_x^*(t_1)$; then $M^{**} - M_0 = -dM$ and $\omega^{**} - \omega_0 = -d\omega$

Third path The last shock occurs at time t_2 and is permanent. As it hits the savings rate and possibly the real wage jump again and the economy links to a third and final path which is convergent. In other words, since the shock is permanent, utility maximization will imply a "stable arm" path to a saddle point stable equilibrium. Therefore, from t_2 to infinity, the two equations below describe the dynamic system and the constant k_7 associated with the positive eigenvalue is zero.

$$S_t = \lambda_1 k_7 e^{\lambda_1 t} \tag{7.7}$$

$$\varpi_t - \varpi_0 = \frac{\lambda_1 k_7 C_4}{\lambda_1 - C_5} e^{\lambda_1 t}, \tag{7.8}$$

$$M_t - M^0 = k_7 e^{\lambda_1 t}, \tag{7.9}$$

7.0.4. Restrictions

To solve for the seven unknowns constants we need an equal number of boundary conditions. Firstly, we can exploit the initial conditions on the stock of nominal money balances in the same way as earlier derived for the permanent shock. Since M is pre-determined, equation (7.3) can be used at $t = 0$ to describe the relationship between the change in steady state money stock and the three first constants,

$$-(M^* - M^0) = k_1 + k_2 + k_3$$

$$\Rightarrow k_1 = -(dM + k_2 + k_3) \tag{7.10}$$

Secondly, at $t = t_1$ equations (7.3) and (7.6) both report nominal money stock at the same moment in time and must therefore give the same solution:

$$k_4 e^{\lambda_1 t_1} + k_5 e^{\lambda_2 t_1} + k_6 e^{\lambda_3 t_1} - k_1 e^{\lambda_1 t_1} - k_2 e^{\lambda_2 t_1} - k_3 e^{\lambda_3 t_1} = 2dM \tag{7.11}$$

Thirdly, the same condition applies at $t = t_2$, when the next shift occurs and equations (7.6) and (7.9) must give the exact same information for the level of nominal cash balances:

$$k_4 e^{\lambda_1 t_2} + k_5 e^{\lambda_2 t_2} + k_6 e^{\lambda_3 t_2} - k_7 e^{\lambda_1 t_2} = dM \tag{7.12}$$

Four other restrictions are still needed and they can be derived from the fact that S, and possibly ϖ, will jump at time t_1 and again at t_2. The magnitude of the jumps amounts to the difference in how the above system of equations reports the savings rate and the real wage immediately before and after the shocks. Thus the jump in S at t_1; which is noted as J_1; can be defined by subtracting eq. (7.1) from eq. (7.4) and similarly the savings jump at t_2; which is noted as J_2; must be the difference between (7.4) and (7.7),

$$J_1 = \lambda_1 k_4 e^{\lambda_1 t_1} + \lambda_2 k_5 e^{\lambda_2 t_1} + \lambda_3 k_6 e^{\lambda_3 t_1} - \lambda_1 k_1 e^{\lambda_1 t_1} - \lambda_2 k_2 e^{\lambda_2 t_1} - \lambda_3 k_3 e^{\lambda_3 t_1} \quad (7.13)$$

$$J_2 = \lambda_1 k_7 e^{\lambda_2 t_2} - \lambda_1 k_4 e^{\lambda_1 t_2} - \lambda_2 k_5 e^{\lambda_2 t_2} - \lambda_3 k_6 e^{\lambda_3 t_2}: \quad (7.14)$$

In similar fashion, using the equational pairs (7.2), (7.5) and (7.5), (7.8) respectively, the two jumps in ϖ at same time points, noted as J_3 and J_4;can be characterized as,

$$J_3 = -2d\varpi + C_4\left[\frac{\lambda_1(k_4 - k_1)}{\lambda_1 - C_5}e^{\lambda_1 t_1} + \frac{\lambda_2(k_5 - k_2)}{\lambda_2 - C_5}e^{\lambda_2 t_1} + \frac{\lambda_3(k_6 - k_3)}{\lambda_3 - C_5}e^{\lambda_3 t_1}\right] \quad (7.15)$$

$$J_4 = d\varpi + C_4\left[\frac{\lambda_1(k_7 - k_4)}{\lambda_1 - C_5}e^{\lambda_1 t_2} - \frac{\lambda_2 k_5}{\lambda_2 - C_5}e^{\lambda_2 t_2} - \frac{\lambda_3 k_6}{\lambda_3 - C_5}e^{\lambda_3 t_2}\right] \quad (7.16)$$

7.1. Explicit solutions: Getting expressions for J_1-J_4

This is a utility optimization under the assumption of a perfect foresight. No new information arrives after $t = 0$ and the multiplier μ must therefore be constant after an initial jump. Given this fact, the first order conditions derived from utility maximization can be used to determine the immediate impact on S by a change in P_x^* at $t = t_1$ and at $t = t_2$.

$$V_E(P_n; P_m; E) = \mu: \quad (7.17)$$

By total differentiating (7.17) and applying similar transformations as before we obtain,

$$\tau\gamma_n \hat{P}_n + (\tau\gamma_m + \alpha_x - \gamma_m)\hat{e} + \gamma_n \hat{Q}_n + \alpha_x \hat{P}_x^* - \frac{dS}{E} = d\mu = 0$$

Then equations (2.22) and (2.23) can be used to eliminate $\hat{P}_n$ and $\hat{e}$ and we obtain the following solutions,

$$\frac{dS(t)}{E} = N_3^{-1}\left[N_1 \hat{\varpi}(t) + N_2 \hat{P}_x^*(t)\right] \quad (7.18)$$

$$N_1 = (\tau[\varepsilon Z\theta_L^x + \gamma_m \kappa_n \theta_L^n(\gamma_n + \gamma_m Z\theta_L^x)] - \gamma_n \varepsilon \kappa_n \theta_L^n(1 - Z\theta_L^x))$$

$$N_2 = \tau\,[\gamma_n\gamma_m - Z\varepsilon - \kappa_n\theta_L^n\gamma_m\gamma_m Z] + \gamma_m[\varepsilon + \kappa_n\gamma_m\theta_L^n](1 - Z\theta_L^x)$$

$$N_3 = [\tau\gamma_n + (\varepsilon + \gamma_m\kappa_n\theta_L^n)(1 - Z\theta_L^x)]$$

The determination of J_3 and J_4 depends on the labor market response to the anticipated devaluations at t_1 and t_2. If the unions demand nominal wage changes to avoid jumps in the real wage, we can safely conclude that $J_3 = J_4 = 0$. However, on the other hand, if the nominal wage is fixed as the shock occurs, then the jumps can be determined directly from the change in the price level. If we assume that the nominal wage is predetermined as the shocks occur, i.e. $J_3, J_4 \succeq 0$, then the jump in the real wage will amount the change in general price level as result of export price change,

$$\hat{\varpi}(t_j) = -\hat{P}(t_j). \quad j = 0, 1, 2. \tag{7.19}$$

From equations, (2.22) and (2.23), substituting for $\hat{P}$ in (7.19) given the relationship between changes in the real wage, savings and the export price,

$$\hat{\varpi}(t) = [\varepsilon + \gamma_m\kappa_n\theta_L^n]^{-1}\left[\gamma_n\frac{dS(t)}{E} - [\gamma_m\gamma_n - Z\varepsilon - \kappa_n\theta_L^n\gamma_m\gamma_m Z]\hat{P}_x^*(t)\right] \tag{7.20}$$

Now given that $\hat{P}_x^*(t_1) = -2\hat{P}_x^*(t_2)$, and thus $J_1 = -2J_2$ and $J_3 = -2J_4$, we have sufficient information from equations (7.20) and (7.18) to quantify the four jumps if the unions will refrain from nominal wage increases as the shocks occur,

$$J_i = \left[\frac{N_2[\varepsilon + \gamma_m\kappa_n\theta_L^n] - N_1[\gamma_m\gamma_n - Z\varepsilon - \kappa_n\theta_L^n\gamma_m\gamma_m Z]}{N_3[\varepsilon + \gamma_m\kappa_n\theta_L^n] - N_1\gamma_n}\right]\hat{P}_x^*(t_i); \ i=1,2. \tag{7.21}$$

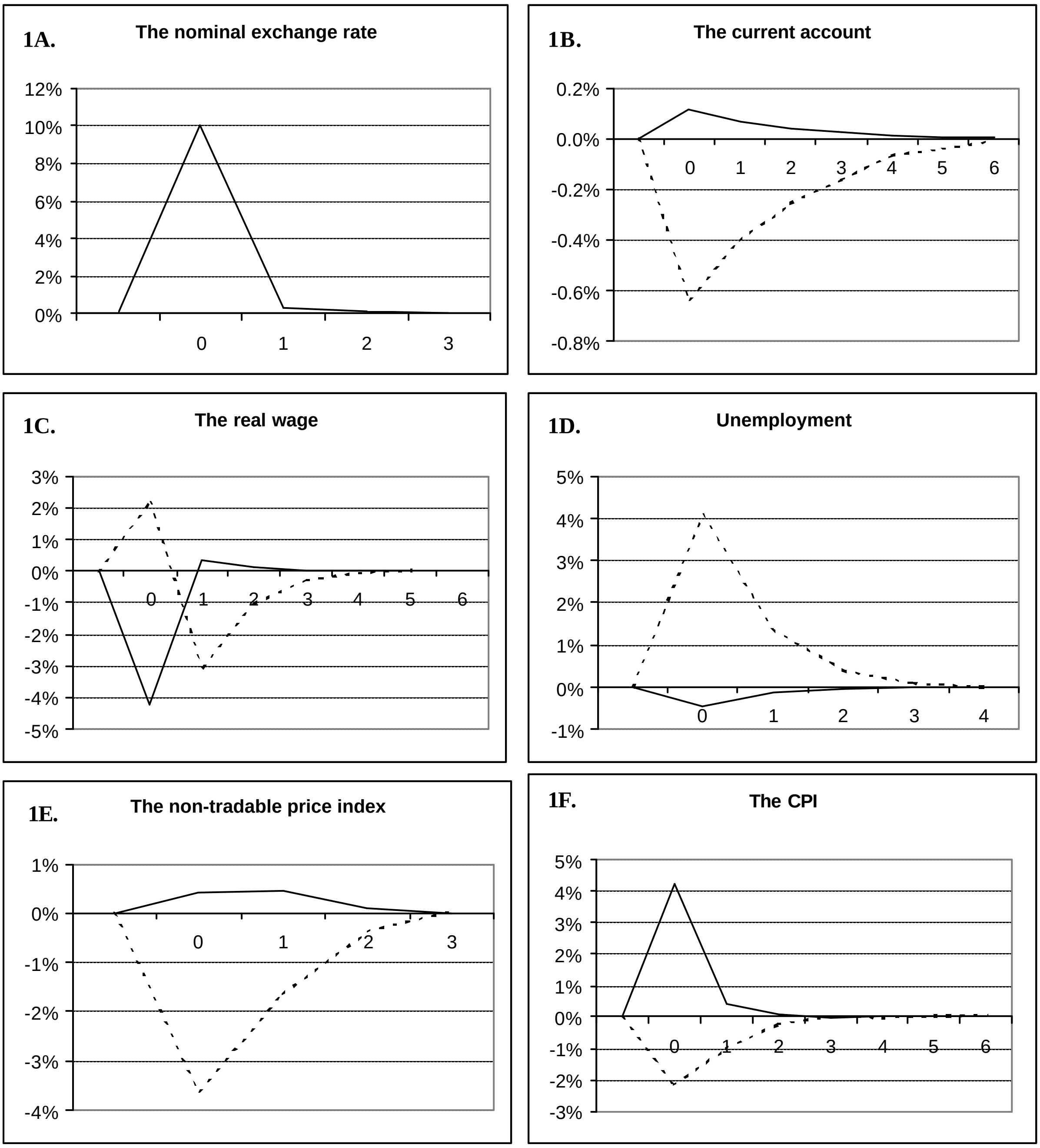
$$J_3 = [\varepsilon + \gamma_m\kappa_n\theta_L^n]^{-1}\left[\gamma_n J_1 - [\gamma_m\gamma_n - Z\varepsilon - \kappa_n\theta_L^n\gamma_m\gamma_m Z]\hat{P}_x^*(t_1)\right] \tag{7.22}$$

$$J_4 = [\varepsilon + \gamma_m\kappa_n\theta_L^n]^{-1}\left[\gamma_n J_2 - [\gamma_m\gamma_n - Z\varepsilon - \kappa_n\theta_L^n\gamma_m\gamma_m Z]\hat{P}_x^*(t_2)\right] \tag{7.23}$$

Otherwise, if the unions do not refrain from demanding nominal wage adjustments in response to exchange rate interventions and the real wage does not jump then,

$$J_i = \frac{N_2}{N_3}\hat{P}_x^*(t_i); \ i = 1, 2.; \tag{7.24}$$

$$J_3 = J_4 = 0. \tag{7.25}$$

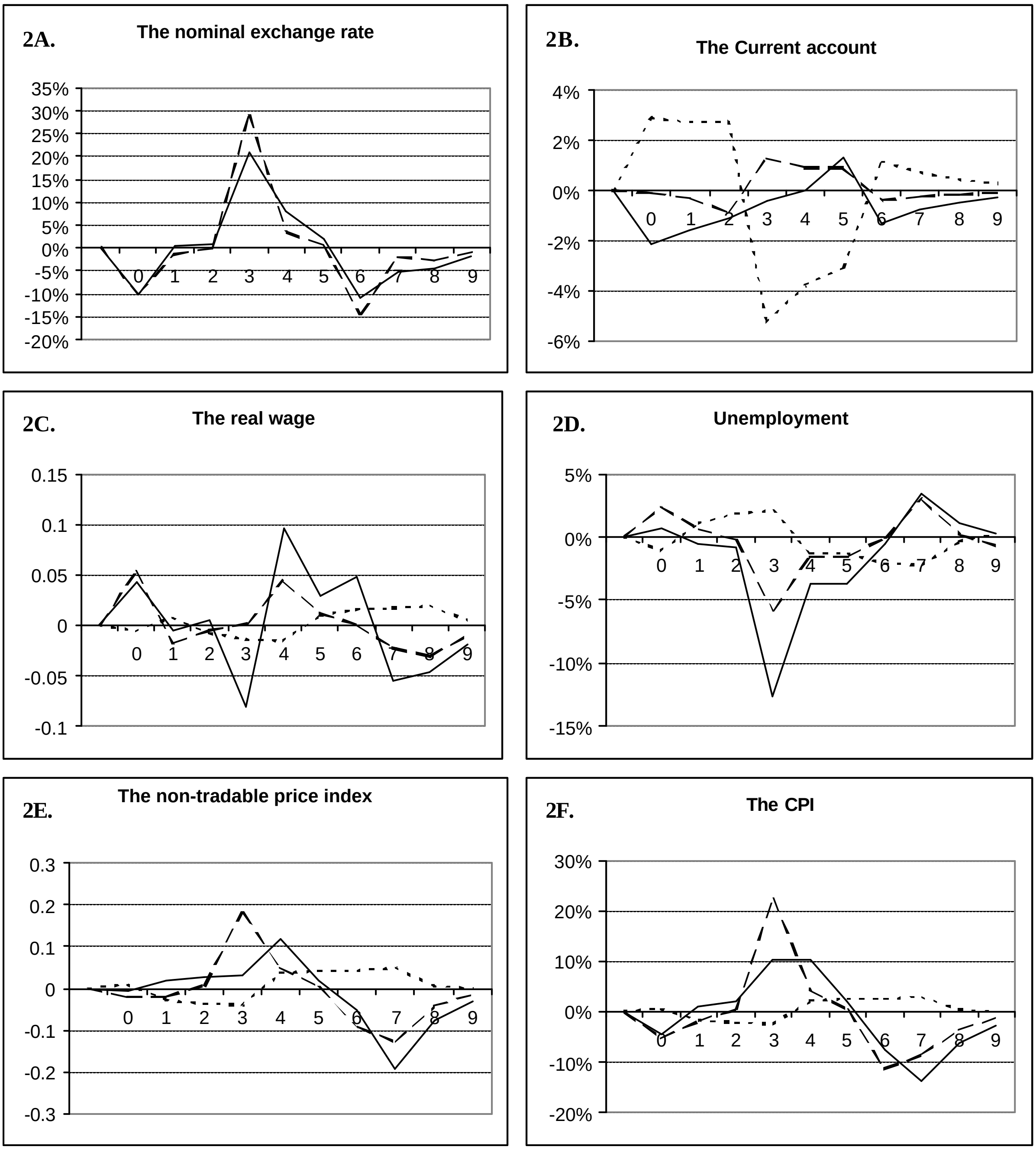


The effect of 10% permanent negative export price shocks under two regimes:

Exchange rate intervention (——). The government does adjust the nominal exchange rate in response to shocks to the export sector

Non-intervention (- - - -). The exchange rate is fixed and there is no policy intervention.

In this scenario intertemporal substitution is equal to 0.45 and cross price elasticity is 0.45.



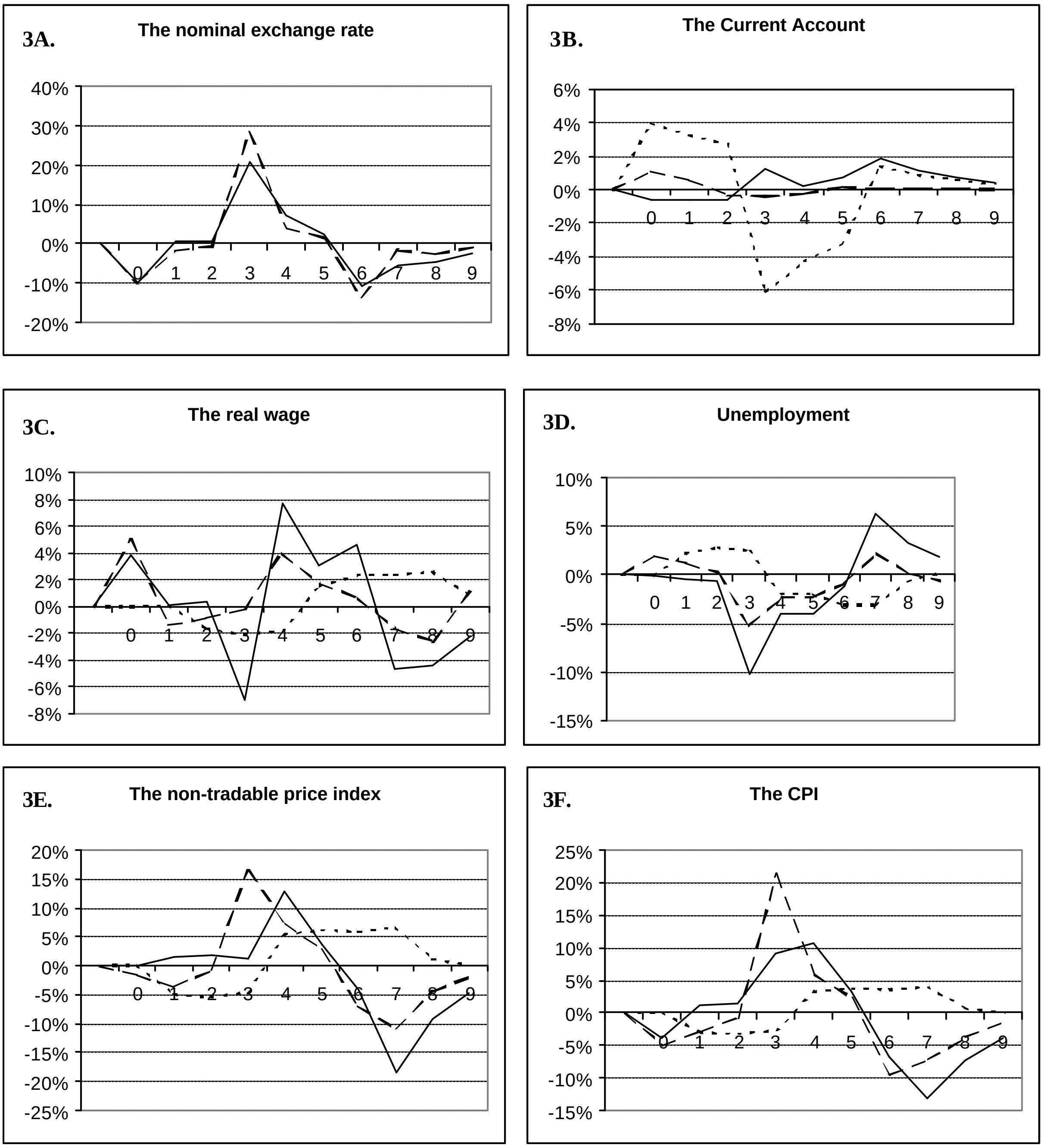
The effect of three subsequent export price shocks, 10% increase at t=0, 20% decrease at t=3 and 10% increase at t=6, under the three regimes:

Cooperation (——). The labor unions do not demand an instant nominal wage adjustment to compensate for the devaluation that occurs in year 3 in response to a 20% negative export price shock. In other words, nominal wage is fixed as the shock occurs, but the real wage jumps.

Non-cooperation (— —). The labor unions will demand a nominal adjustment in response to an anticipated devaluation. In other words, the nominal wage jumps as the shock occurs.

Non-intervention (- - - -). The exchange rate is fixed and there is no policy intervention.

In this scenario intertemporal substitution is equal to 0.8 and cross price elasticity is 0.65.



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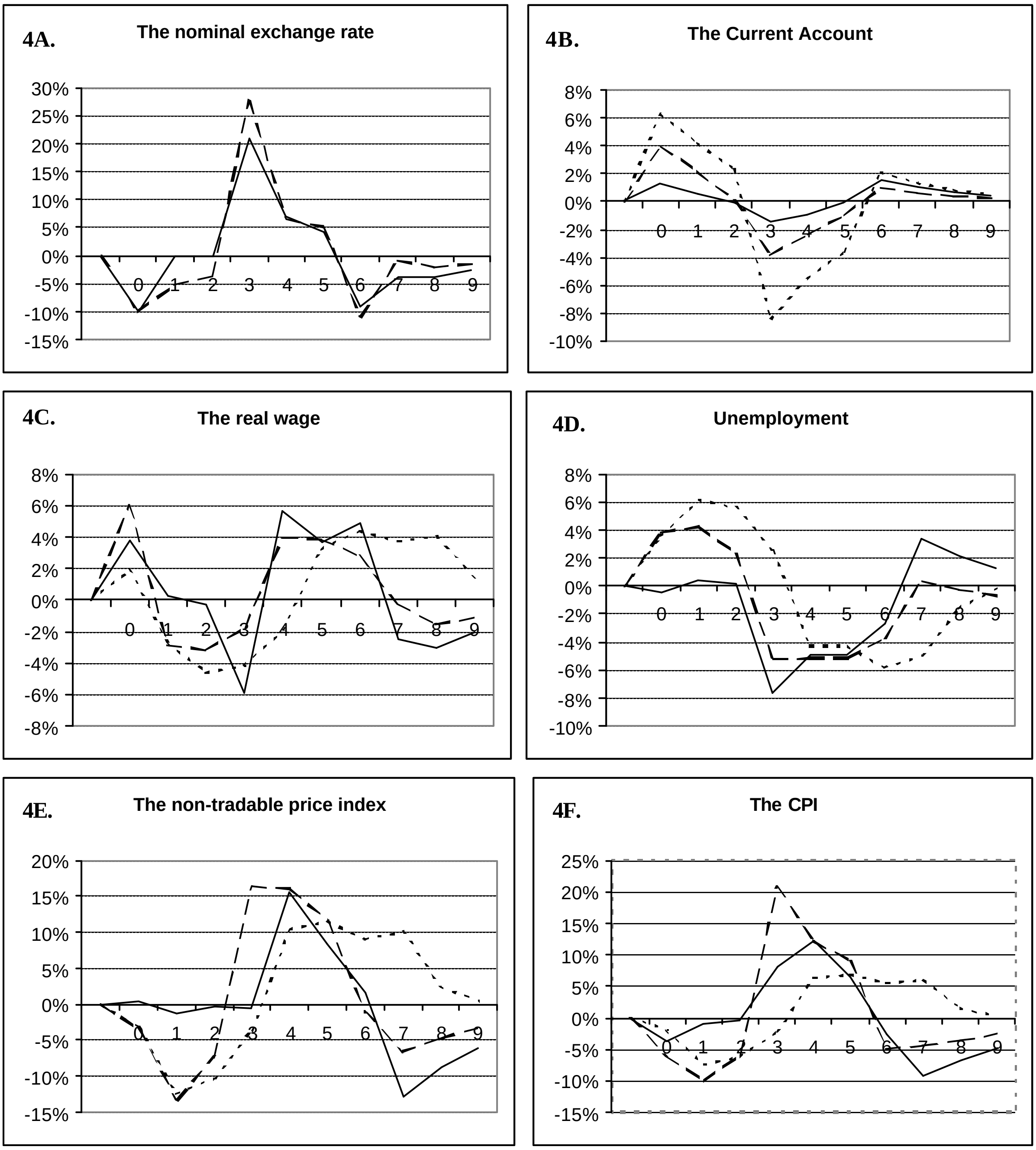

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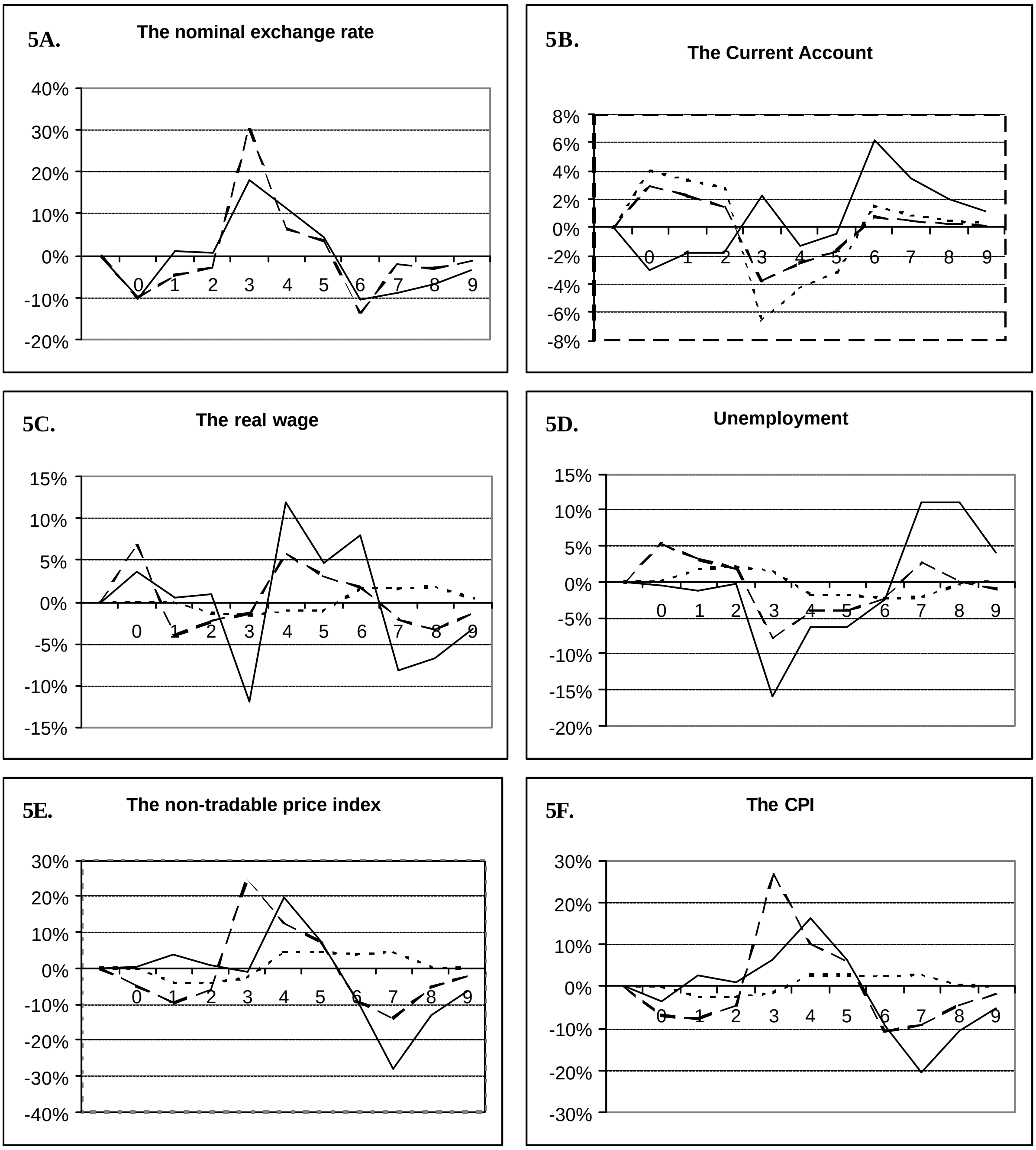
Non-cooperation (— —). The labor unions will demand a nominal adjustment in response to an anticipated devaluation. In other words, the nominal wage jumps as the shock occurs.

Non-intervention (- - - -). The exchange rate is fixed and there is no policy intervention.

In this scenario intertemporal substitution is equal to 0.8 and cross price elasticity is 0.25.



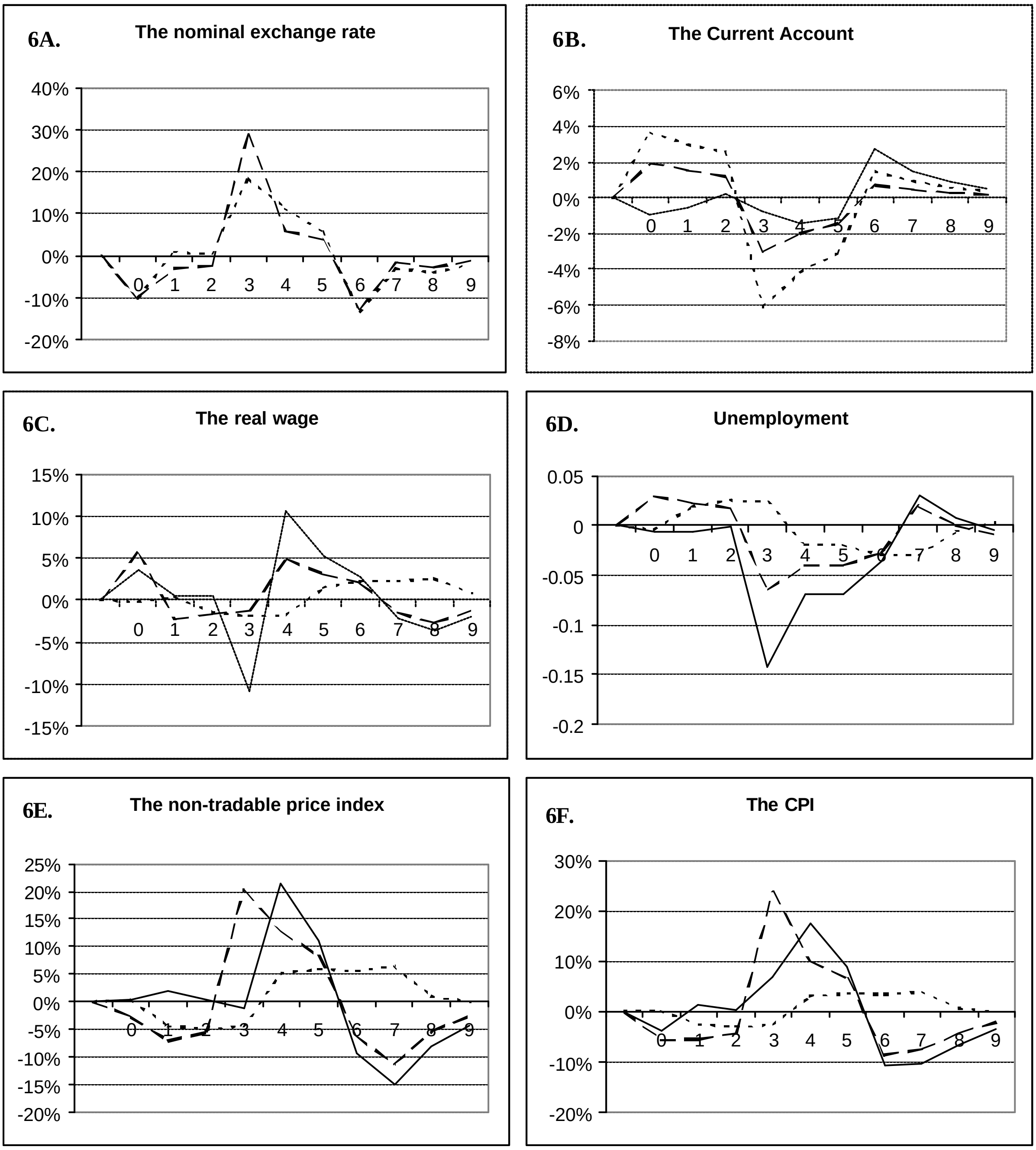
The effect of three subsequent export price shocks, 10% increase at t=0, 20% decrease at t=3 and 10% increase at t=6, under the three regimes:

Cooperation (——). The labor unions do not demand an instant nominal wage adjustment to compensate for the devaluation that occurs in year 3 in response to a 20% negative export price shock. In other words, nominal wage is fixed as the shock occurs, but the real wage jumps.

Non-cooperation (— —). The labor unions will demand a nominal adjustment in response to an anticipated devaluation. In other words, the nominal wage jumps as the shock occurs.

Non-intervention (- - - -). The exchange rate is fixed and there is no policy intervention.

In this scenario intertemporal substitution is equal to 0.25 and cross price elasticity is 0.65.



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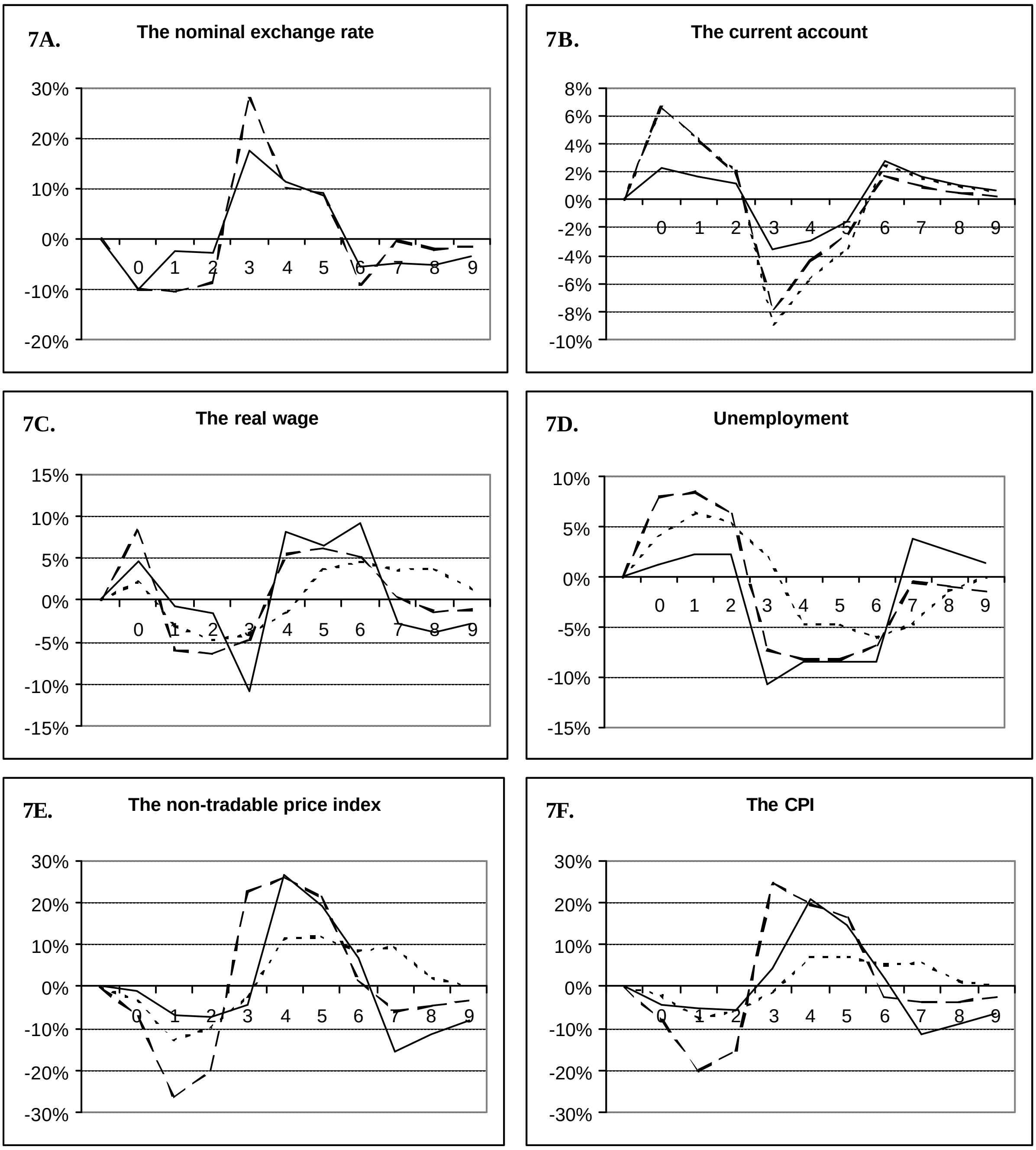

The effect of three subsequent export price shocks, 10% increase at t=0, 20% decrease at t=3 and 10% increase at t=6, under the three regimes:

Cooperation (——). The labor unions do not demand an instant nominal wage adjustment to compensate for the devaluation that occurs in year 3 in response to a 20% negative export price shock. In other words, nominal wage is fixed as the shock occurs, but the real wage jumps.

Non-cooperation (— —). The labor unions will demand a nominal adjustment in response to an anticipated devaluation. In other words, the nominal wage jumps as the shock occurs.

Non-intervention (- - - -). The exchange rate is fixed and there is no policy intervention.

In this scenario intertemporal substitution is equal to 0.25 and cross price elasticity is 0.25.

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