



STUDIECENTRUM VOOR ECONOMISCH EN SOCIAAL ONDERZOEK

VAKGROEP MACRO-ECONOMIE

**Stabilization with wage indexation
and exchange rate flexibility
-a survey of the literature-**

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rapport 93/283

January 1993

I am most grateful to J. Plasmans and A. Van Poeck for helpful comments and criticisms on a previous draft of this survey article.

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D/1993/1169/01

Abstract

This survey examines the role of *wage indexation* and *exchange rate policy* in dampening fluctuations in output around its target level. It is demonstrated that the appropriate choice for wage indexation and exchange rate flexibility is highly sensitive to the nature and the relative importance of the shocks impinging upon the economy as well as to the relevant parameters in the economy. Moreover, the question of the desired flexibility of the exchange rate should be studied in the context of wage indexation, and vice versa. This interdependence raises the possibility of both policies being complements or substitutes to each other depending on the number of shocks that perturb the economy.

1. Introduction

Although wage indexation and exchange rate policy already became topical in the macroeconomic literature some decades ago, it is only recently that economists have addressed themselves to the combination of these two issues. This paper provides a review of the most important contributions on wage indexation and exchange rate policy, focusing on the potential for both to stabilize the economy. In section 2 we deal with the implications of wage contracts and wage indexation for macroeconomic stability. The question of alternative exchange rate regimes is addressed in section 3. Section 4 analyzes wage indexation and exchange rate policy as joint issues. In the final section, we formulate some interesting topics for future research.

Before starting the overview, it is useful to mention some important restrictions. Throughout, this review of the literature is primarily conducted from the viewpoint of output stabilization, as is common in much of this literature. In most of the papers, the existence of longer-term wage contracts introduces 'friction' into the system and when the economy is subject to shocks this results in levels of output others than those that would obtain in a frictionless economy. The task of policy is then to minimize the fluctuations in output about its 'desired' level, with the latter being defined as the level of output that would prevail if wages were fully flexible and not preset by contracts¹. Ideally, we should consider all the target variables of concern to the authorities, including ,e.g., prices as well as output. The advantage of this is that it enables us to say something about potential trade-offs between different targets. Unfortunately, such analyses are difficult to undertake since model solutions

¹ In some papers output is minimized relative to 'expected' or 'full information' output rather than to its frictionless level.

would multiply giving rise to complexity and confusion ². Finally, it should also be mentioned that we do not attempt to discuss the whole debate on exchange rate policy, but rather restrict ourselves to its stabilization properties ³.

2. Wage indexation and macroeconomic stability

2.1. Wage indexation: Can full output stabilization be achieved?

The stabilization aspects of indexing wages to prices were recognized by a variety of early writers. Indexation was first proposed in 1807 by Wheatley, an English writer on money, and only a century later it was enthusiastically supported by several great economists, including Jevons (1896), Fisher (1922), Marshall (1925) and Pigou (1933). It is important to notice that these early writers, with the exception of Pigou, confined their discussions to frameworks which admit only monetary disturbances. Later proponents of indexing, Friedman (1974) and Giersch (1974), continued to consider sticky real wages as being more conducive to output stability than sticky nominal wages under monetary disturbances. Another prevalent view, however, was that wage indexation exacerbates economic instability by reducing the responsiveness of the economy to disturbances that require real wage changes (examples of such disturbances include supply shocks such as a change in labour productivity), see Bernstein (1974).

In a framework of *contractually fixed nominal wages* Gray (1976) and Fischer (1977a) have shown that either of the above prevalent views is correct under appropriate circumstances, i.e. output tends to be more stable in an indexed system than

² Nevertheless, we recognize that the authorities' choice of their objectives is one of the crucial determinants of optimal wage indexation and exchange rate policy.

³ The debate on exchange rate regimes also revolved around other issues, like, e.g., the harmonization of economic policies required for the proper functioning of various exchange rate regimes (see e.g. Kenen (1987)), and the policy discipline likely to be forthcoming under alternative systems (see e.g. Rogoff (1985)).

in a non-indexed system when disturbances are *nominal*⁴, while output tends to be more stable in a non-indexed system than in an indexed system when disturbances are *real*⁵. Full indexation keeps the real wage constant. If shocks are purely nominal, output stability requires the nominal wage to increase proportionally with the price level. Hence full indexing stabilizes output if shocks are nominal. When shocks are real, however, the level of output can be kept constant only if the real wage adjusts. Since indexation prevents the necessary adjustment in the real wage, the shock is absorbed through changes in the level of output.

Since indexation cannot be turned on and off at will by the authorities, the Gray-Fischer analyses suggest a *degree of partial indexation that depends on the relative magnitudes of the two types of disturbances*. Consequently, optimal indexing will not, in general, stabilize the economy completely for all disturbances simultaneously. The reason that only partial stabilization can be obtained is that the number of disturbances exceeds the number of contemporaneous pieces of information that form the indexation rule. As noted by Aizenman and Frenkel (1985b), this rule can be considered as a supplement to Tinbergen's theorem concerning the relation between targets and instruments of economic policy. In the case noted above the single target for policy is to eliminate

⁴ In the dispute of output responses to nominal shocks, Sargent and Wallace (1975) suggested that the behaviour of output is invariant to monetary disturbances if expectations are formed rationally and if all contracts are made for just one period. Since then, many writers have challenged this result. E.g., if there are *longer-term nominal wage contracts*, then, as Fischer (1977a) has shown, the presence of sticky wages implies that monetary disturbances, even if they are anticipated, can affect output. The debate continued in Barro (1977) and Fischer (1977b). Barro argued that if optimal contractual arrangements are specified for determining both wages and employment (which is made contingent upon shocks perceived after wages are set), the output effects of monetary disturbances disappear. Such contracts, however, are much too elaborate and bear little resemblance to actual contracts, as Fischer observed.

⁵ The conclusion that indexation destabilizes output when shocks are real rests crucially on the assumption of employment being determined in disequilibrium along the demand curve for labour (see Cuckierman (1980)). If employment is determined along the supply curve for labour, indexing may stabilize output even when shocks are real. This reversing of results suggests the crucial importance of the assumed employment rule for the assessment of the effects of wage indexation.

the distortion to the wage implied by contracting. The target can be attained by the single instrument of indexation. *This instrument is only capable of attaining the target if it is triggered by a sufficient number of independent indicators which must equal the number of disturbances* ⁶. With several disturbances impinging upon the economy, an optimal indexation policy that completely eliminates the distortion requires a sophisticated wage indexation formula that is not limited to respond only to changes in the price level.

In Gray's and Fischer's model, two disturbances are introduced, a real and a monetary one, and just one piece of contemporaneous information, the price of output. They, therefore, are able to achieve only partial stabilization with the two disturbances they consider. Karni (1983) achieved full stabilization in a similar model by indexing wages to output as well as to its price. Then there exists an optimal indexation rule such that the economy can replicate the behaviour of a fully flexible wage economy ⁷. The optimal indexation rule thus serves to nullify the distortions arising from the assumption that, because of labour contracts, nominal wages are predetermined. However, since output quantities are generally less precisely observable than prices in the time frame envisaged (i.e. output data are less readily available), indexation to output is less appealing. Therefore, in discussing indexation, it is important to distinguish between those variables that the authorities can in effect currently observe and those that at least in the short run are unobservable. Indeed, given that data on prices are available with much greater frequency than output figures, indexing to output is practically impossible.

⁶ As we will see further on in this survey, optimal exchange rate policy also crucially depends on this rule.

⁷ Marston and Turnovsky (1985) and Aizenman and Frenkel (1986) presented an indexation rule that is analogous to Karni's rule, except that wages are tied to productivity disturbances rather than to the output level. As in Karni (1983), it is shown that at the optimum the nominal wage must adjust to changes in the price level by an indexation coefficient of unity, whereas its adjustment to the productivity shock (or to output in Karni (1983)) differs from unity.

2.2. Wage indexation in labour contracting models versus incomplete information models

The Gray-Fischer models examine the role of wage indexation in a framework with a *contractually fixed nominal wage* as the central feature. The motivation for longer-term contracts in these models derives from costs of renegotiations⁸. Such an institutional setup requires that the terms of wages be agreed upon by firms and workers prior to the realization of the disturbances (e.g., one period ahead). Once contracts have been negotiated, the level of employment becomes completely demand determined for the period of the contract. Workers are assumed to supply whatever amount of labour is demanded by firms at the negotiated wage rate. This contractual setup introduces *friction* into the system and results in levels of output and employment other than those that would obtain in a frictionless economy. When the economy is subject to shocks, the labour market is thrown out of equilibrium because of sticky nominal wages. The beneficial effects of indexation then stem from allowing the wage to respond to current information (about the prevalent disturbances) which could not have been foreseen at the time of the wage negotiation⁹. The welfare criterion then involves minimizing the deviation of actual output from output which would prevail in a perfectly frictionless economy (i.e. an economy without contracts). The rationale for this criterion lies in the inefficiency associated with the existence of contracts. The objective of indexation is then to undo (part of) the distortions caused by these contracts.

The analyses above are presented assuming complete current information regarding all economic variables. Studies

⁸ Implicit in most studies incorporating longer-term contracts is the assumption that economic agents are risk neutral. By allowing for risk aversion, contracts could also be rationalized in terms of an insurance element.

⁹ When indexing wages, it is assumed that at each point in time the current value of the price can be observed.

that consider wage indexation in the context of *incomplete information* are relatively rare. Barro (1976) analyzed the effects of indexing in a market-clearing framework that excludes long-term contracting. However, by containing sufficient limitations on the flow of information, a similar supply curve-type relationship can be generated (cf. the incomplete information type of model considered by Lucas (1973))¹⁰. As opposed to a framework of long-term contracting and wage rigidities, rigidities which dominate short-run supply behaviour in Barro result from individuals' lack of information on some of the prices relevant in their decisions. Two types of shocks are presented in such a framework (which due to incomplete information cannot be observed separately): an aggregate shock that affects all industries identically and a relative shock that is industry-specific. Individuals only observe disturbances that impinge on their own industry and misinterpret general price movements for relative price movements. The levels of output and employment are determined after the realization of the disturbances but before the general price becomes known. This means that firms, who infer the magnitude of the disturbances from industry-specific price formation, must make their production and employment decisions on the basis of uncertain prices and labour costs. An essential feature of these models is the fact that, instead of making decisions on the basis of realized prices and wages, firms decide on the basis of expected values of these variables. The confusion between relative and absolute price disturbances corresponds to a confusion between relative and absolute wage disturbances and therefore involves a change in output and employment. This is because firms expect the price of their output, but not their wage costs, to change following a relative shock¹¹. In this labour market setup the slope of the output

¹⁰ For a similar setup of the labour market, although without indexation, see Cox (1980).

¹¹ Relative disturbances are not expected to affect the general price level. Hence, wages are not expected to change either. For aggregate disturbances, however, wage costs are expected to rise in the same proportion as the price firms receive for their output.

supply curve is determined by the variance in relative wage rates relative to economy-wide variance in wage rates, as in Lucas (1973). Since in those kinds of models *indexation operates as an ex-post adjustment of wages in accordance with the general disturbances, it in no way alters the information available to individuals at the time decisions are made and therefore has no effect at all on the response of the real sector to disturbances of any kind.* Output is determined at date t , and is therefore unaffected by the indexing adjustment that will occur at date $t+1$. Models of this kind give no support to the familiar hypothesis that indexation can be used to eliminate part of the fluctuations in output. Hence, in an incomplete information framework where both relative and general shocks are part of the stochastic structure of the economy, indexation neither insulates the real sector from monetary disturbances, nor exacerbates the effect of real shocks.

For an analysis that contains elements of *both classes of models*, see Gray (1983). It combines contractual arrangements with an incomplete information structure. It is crucial in such an analysis that the slope of the supply curve does not only depend on the extent to which wages are indexed but also directly on the stochastic structure of the economy (i.e. the relative magnitude of aggregate and relative shocks). Although the curve becomes steeper as the degree of wage indexation rises, it does not become vertical under full indexation. Full indexation no longer completely insulates the real sector from monetary disturbances when information is incomplete. Indexing can neutralize only that part of the monetary disturbance that is correctly perceived to be an aggregate disturbance. Changes in demand due to an aggregate disturbance will however be partially misperceived. Some part will be mistakenly perceived as a relative disturbance which in turn changes output, even if wages are fully indexed.

2.3. Some further considerations on wage indexation

a. Frequency of wage indexation and wage renegotiations

The previous sections have shown that the existence of wage contracts introduces rigidities into the economy because they limit the capacity of wages to adjust to shocks. In addition to the degree of wage indexation there exist two other channels that allow some wage flexibility: a change in the frequency of wage indexation and wage renegotiation ¹².

Guiso (1985) introduced the *frequency of wage indexation* in the Gray-Fischer models with wages responding partly to the current price level and partly to lagged prices. For instantaneous indexation (i.e. there is no lag in the adjustment of nominal wages to price changes) a high frequency of adjustment within the contractual period is needed. Clearly, in reality this assumption is not realistic (see footnote 12) and indexation partly adjusts wages to inflation in the previous period. If indexation is completely instantaneous (highest frequency of adjustment), wages respond only to the current price level, whereas with indexing once (lowest frequency of adjustment, with no instantaneous adjustment) wages respond only to the one period lagged price level ¹³. The presence of a lag in the adjustment of wages to prices causes the effects of the shocks to persist. In the case of a *nominal* shock a low frequency of indexation within the contractual period, for a given degree of indexation, is shown to amplify both the impact on output and the duration of the shock. When shocks are *real* a low

¹² The justification for the absence of instantaneous indexation and the existence of labour contracts is that there are likely to be costs associated with wage renegotiations and an instantaneous adjustment of wages to changes in prices. These costs involve gathering and processing current information (costs of surveys, costs of constructing price indices, etc.), increased frequency of wage payments or costs of negotiating the details of a contract. These costs make a continuous market clearing a second best possibility. In the absence of costs associated with contracting and indexing, the optimal contract length would be zero.

¹³ It is assumed that this is the maximum feasible lag. The indexation scheme can be formulated as follows: $w = a(fp - (1-f)p_{-1})$ where a indicates the degree and f the frequency of indexation. $0 \leq f=1-1/n \leq 1$ with n the number of adjustments.

frequency reduces the impact on output but increases persistence while a high frequency amplifies the impact effect of the shock but output returns quickly to normal ¹⁴.

Gray (1978) and Aizenman (1984) have shown that shortening the contract length implies smaller welfare losses caused by the deviation of the contract wage from the market clearing wage. Indeed, by increasing the *frequency of renegotiation* wages resulting from the contract will deviate less from the market clearing wage in a flexible economy. Increased variability of the shocks, regardless of source, and decreased contracting costs will increase the desirability of recontracting and therefore shorten contract length. Similarly, optimal wage indexation has the effect of reducing volatility reducing in turn the use of recontracting. Any movement away from the optimal degree of indexing therefore involves a decreasing optimal contract length. An increase in both *monetary or real variability* results in a lower optimal contract length, while the optimal degree of indexation increases with monetary variability and decreases with real variability (see before) ¹⁵.

b. Wage indexation and more specific labour market settings

The indexation literature based on Gray and Fischer presumes the existence of a purely aggregate economy. Recent research on indexation has shown that results regarded as standard may not always fully apply to more specific labour market settings. Several attempts have been made to examine the implications of particular assumptions, such as ,e.g., the existence

¹⁴ The optimal frequency of wage indexation does not only depend on the stochastic structure of the economy but also on the costs involved with the frequency of adjusting wages to prices and on the prevalent degree of indexation. Guiso also derived the joined optimization of the frequency and the degree of indexation.

¹⁵ An important difference between optimal indexation on the one hand and optimal frequency of indexation or recontracting on the other, is that the former depends only on the relative importance of the real and monetary shocks, whereas both the latter depend on the absolute variability of the shocks.

of alternative forms of wage contracting behaviour and the existence of heterogeneous labour.

Duca and Vanhooose (1991) analyzed indexation in an economy where one sector has wage contracts and another has a labour market in which the labour market clears instantaneously. In the wage-contracting sector, wages are indexed to a weighted average of the economy-wide price and the sector-specific price. This difference reflects that producers seek to minimize real wages in terms of their sectoral goods price, while workers seek to maximize their real wage in terms of the economy-wide price. Wages are also tied to sector-specific productivity disturbances. These disturbances create a terms-of-trade effect between the sectors that cannot be offset fully through indexation only to aggregate variables. In contrast to an aggregate economy, optimal indexation, therefore, must include both economy-wide and sector-specific variables. As the output share of the contract sector increases, the degree to which wages are indexed to the sectoral price and the sectoral productivity disturbance increases, and the degree to which wages are indexed to the economy-wide price decreases.

Kovanen (1992) assumed that not every unit of labour is identical and that different indexation clauses are applied throughout the whole economy. He showed that if wages are determined by economy-wide bargaining with a common indexation rule throughout the economy (i.e. everyone is allowed to index), the optimality of wage indexation is not influenced by the assumption of heterogeneous labour. However, if only a portion of the labour force is allowed to index, the optimal degree of indexation depends on the type of labour (skilled and highly productive, or unskilled and less productive). As shown by Kovanen, the optimal degree of indexation for a single group of labour does not coincide with the optimal degree under economy-wide common indexation: when only a single group of labour is indexing, the optimal degree indexation to nominal shocks exceeds unity. For real shocks, on the other hand, optimal indexing is less than in the economy-wide

indexing case.

c. The underlying motivation for the authorities' intervention into wage indexation

Up till now, we analyzed indexation as if the authorities were conducting the policy. However, the authorities' proper role in regulating indexation depends on whether there are some market failures or externalities that prevent the economy itself from producing the optimal degree of indexation in privately-negotiated wage contracts ¹⁶. What particular market failures do we have in mind which would lead us to consider a government indexation policy to be desirable?

In the recent literature on indexation several authors have addressed the possibility that optimal indexation does not occur in privately-negotiated contracts. In such cases, government policy to influence indexation could raise welfare. E.g., when only a single group of the economy is allowed to index, a non-indexing group may receive positive or negative externalities from indexation. Ball (1988) has shown that indexation costs lead some firms not to index (see footnote 12 for the costs associated with wage indexation), and these firms are unable to offset the effects of other firms' indexation. An increase in the proportion of firms that index makes the price level more responsive to monetary shocks, which affects a non-indexing firm in two ways (the net effect being unclear) ¹⁷. It makes real money less responsive to shocks, which reduces the variance of aggregate demand, and thus the variance of the non-indexing firm's product demand and employment. On the other hand, since the non-indexing firm's nominal wage is fixed, greater responsiveness of the price level implies greater variance of the firm's real wage and its employment. Kovanen (1992) considered the possibility

¹⁶ Hahn (1983) pointed out the importance of identifying market failure when discussing indexation policy.

¹⁷ When both real and monetary shocks exist, the explanation of the externalities becomes more complicated, see Ball (p. 308).

that only a particular labour group in the economy is allowed to index. Under such a condition, a non-indexing labour group may favour or oppose indexation by another group in the economy. A high-productive labour group favours indexation by the low-productive labour group since it receives positive externalities from indexation by this labour group¹⁸. A low-productive labour group, however, is better off if nobody is allowed to index compared to an economy where only the high-productive labour group is allowed to index.

Marston and Turnovsky (1995) and Duca and Vanhooose (1991) have applied Karni's indexation rule to a disaggregated economy. Their indexation formula ties wages in each firm to firm-specific productivity disturbances as well as to the price level. They showed that *firms may have an incentive to misrepresent the true disturbances in order to reduce their wage bill*. If firms can observe their productivity disturbances, but workers cannot, then optimal indexation may not be possible, implying again a possible role for macroeconomic policy¹⁹.

However, although government indexation policy can be motivated, there are also reasons for which a country may be constrained not to use wage indexation for stabilization purposes. Indeed, in several countries indexation is an *institutional or legal fact* rather than a policy instrument, which makes attempts to control wages through indexation almost impossible²⁰. Wage indexation is often a major element in peaceful labour relations (such as, for instance, in

¹⁸ The criterion used by Kovanen to evaluate the use of indexation is to minimize the variance of employment of both types of labour, respectively, around the frictionless level.

¹⁹ The government can eliminate the incentive for the firms to cheat in several ways (e.g. by imposing optimal wage indexation; by combining some optimal tax schedule with privately-negotiated wage indexation).

²⁰ For a summary on different institutional or legal applications of indexation in Europe see Emerson (1983) and OECD (1987).

Belgium and, until recently, in Italy), and the authorities may be unable to injure the indexation mechanism for the sake of stabilization policy.

3. Exchange rate flexibility and macroeconomic stability

3.1. The early debate on exchange rates

Interest in the subject of the relative advantages of fixed and flexible exchange rates dates back to the 1950s, most notably to Friedman (1953) and Meade (1955) ²¹. The debate has been continued by Johnson (1969) and Kindleberger (1969). These early writers were concerned only with the polar cases of fixed and flexible rates and rather constrained their analyses to *basic interests and standard arguments* ²². The discussions were not yet conducted within the framework of fully articulated theoretical models and did not yet primarily focus on the stabilization properties of different regimes. Friedman (1953) argued that a country can realize its major goals of "unrestricted free trade and freedom to pursue internal stability" (p. 202) most efficiently by adopting a flexible exchange rate regime. Following the article by Friedman, Johnson (1969) stressed that a fixed exchange rate regime likely involves restrictions on international trade while floating rates give governments autonomy with respect to their use of monetary, fiscal and other policy instruments without having to worry about eventual balance of payments consequences. Kindleberger (1969), who favoured fixed exchange rates, did not believe in the extra degree of freedom to pursue internal objectives. As he argued, floating would not give governments any extra degree of freedom since they would be likely to adopt exchange rate targets anyway. The gain in autonomy is an illusion since a fluctuating exchange rate

²¹ The early debate on exchange rates can be situated in the exchange rate controversy of the post-war period with the Bretton Woods System of fixed exchange rates being increasingly criticized during the 1950s.

²² Some of the issues in the debate were: Is there less risk and uncertainty under fixed exchange rates?; Do flexible exchange rates allow countries more autonomy with respect to their use of policy instruments?

provides another parameter to be controlled in managing the domestic economy: the exchange rate.

Another major body of the early theory on exchange rates is known as the *optimum currency area theory*. The concept of an optimum currency area has been developed by Mundell (1961). Rather than asking whether a country should adopt a fixed or a flexible exchange rate this literature attempted to determine the bounds of a region within which a single currency would be optimal. Being concerned with the costs of shocks (unemployment, price instability and external imbalance), it specifically considered what structural characteristics of the economy influence the determination of such an 'exchange rate union'. Some of the suggested characteristics were the degree of factor mobility (Mundell (1960)), the degree of openness (McKinnon (1963)) and the degree of diversification of a country's export structure (Kenen (1969)). Ishiyama (1975) and Tower and Willett (1976) provided a comprehensive survey of this literature. Several attempts have been made to test empirically optimum currency area propositions, see e.g. Heller (1977, 1978), Holden et al. (1979) and Weil (1983). These studies have clearly contributed to our understanding of the role of exchange rates in the process of adjustment to disturbances. In optimum currency area theory, relevant country characteristics are central to the analysis. As we will see, in subsequent studies on exchange rates more attention is given to the nature of the disturbances.

3.2. The fixed versus flexible rates debate: formal analyses

A first formal analysis relating macroeconomic stability to the exchange rate system, was provided by Stein (1963). Stein argued that, since a balance-of-payments deficit (surplus) would cause a depreciation (appreciation) of the currency and depreciation stimulates (appreciation weakens) output, one would want the currency to depreciate (appreciate) during periods when the level of output is below (above) normal in order to foster the stability of output. Thus, he concluded,

economies should opt for fixed or flexible exchange rates according to whether or not fluctuations in output under fixed rates (Y) and fluctuations in the balance-of-payments surplus (s) tend to have the same sign (i.e. if $\text{cov}(Y,s) > 0$ Stein's rule prescribes a flexible rate). In a similar model Tower and Courtney (1974) showed that, for flexible rates to make output more stable, a positive covariance is necessary for this to happen, but not sufficient to assure that it will. They showed that adopting flexible rates will make output more stable if and only if $a < 2\text{cov}(Y,s)/\text{var}(s)$, where $a > 0$ is the extent to which output is reduced under flexible rates due to the appreciation of the currency induced by a unitary increase in the balance-of-payments surplus²³. Thus, the smaller a the more likely is exchange rate flexibility to reduce macroeconomic instability.

Other authors used simple variations of the Mundell-Fleming models and analyzed the choice of regime in the face of domestic (and foreign) shocks. Although using a very different framework from that developed by Stein, Turnovsky (1976) obtained results that are consistent with Stein's results. By fully describing the structure of the economy and by considering a great variety of disturbances, his analysis enables to understand more clearly the kinds of factors influencing the sign of $\text{cov}(Y,s)$. The framework adopted in this study is the approach developed by Poole (1970) in his analysis of the *monetary instrument problem*²⁴. The fixed exchange rate is equivalent to pegging the interest rate (under perfect capital mobility); the flexible rate corresponds to pegging the money supply. The problem of choosing between fixed and flexible

²³ In an empirical test, Tower and Courtney showed that a relatively open economy (openness is defined as the level of trade divided by GNP) is more likely to exhibit a positive covariance between payments surpluses and a domestic boom than is a relatively closed one, which makes relatively more open economies better candidates for flexible exchange rates.

²⁴ In his influential article, Poole (1970) showed that the appropriate choice of policy aimed at minimizing fluctuations in output depends on the nature of the shocks that perturb the economy, particularly whether they are of monetary or real origin. Fixing the nominal interest rate is the appropriate policy for money demand shocks but an inappropriate policy for real shocks, which should now be accommodated.

exchange rates is then precisely equivalent to that analyzed for a closed-economy case of choosing between a fixed and a variable interest-rate policy (i.e. Poole's problem carries over exactly to the fixed versus flexible exchange rate question). Using Poole's approach, Turnovsky was one of the very first to show that *the relative stability of output under fixed and flexible exchange rates depends crucially upon the nature of the disturbances impinging upon the economy*. He considered several domestic as well as foreign disturbances. He showed that output will always be more stable under flexible rates if the disturbances are either in foreign trade or in foreign output prices. By contrast, stability will be greater under a fixed rate system if the economy undergoes a domestic monetary disturbance. For all other disturbances he considered (domestic output demand fluctuations, domestic price fluctuations, fluctuations in capital flows) Turnovsky obtained some degree of indeterminacy, depending upon structural as well as policy factors such as the degree of capital mobility and the degree of sterilization. For domestic output demand disturbances, e.g., a fixed exchange rate will lead to more stability for a low degree of capital mobility, while flexible rates will be superior if a high integrated capital market is observed.

A study which departs significantly from Turnovsky (1976) is that of Fischer (1976). In a monetarist model of the balance of payments Fischer found that for a small country a flexible rate is better under monetary disturbances. This result clearly differs from Turnovsky's conclusion. Many differences both in the assumptions and the structure of the two models account for this different result. Fischer did not allow for capital mobility and considered stability from the viewpoint of consumption instead of output. Finally, but most important, he assumed that price variations have no real effects (i.e. output is independent of prices and hence of the exchange rate). As Fischer recognizes, if price level instability produces real instability, then the superiority of floating rates in the face of monetary shocks becomes less

certain. Abstracting from capital flows (i.e. assuming zero capital mobility), Fischer found fixed rates to be more stable in the face of real disturbances, just as in Turnovsky (1976).

As the Turnovsky and Fischer analyses show, one should not expect to be able to derive simple and unambiguous conclusions concerning a country's optimal choice of an exchange rate system. Indeed, the choice of regime crucially depends not only upon the kinds of disturbances but, perhaps even more, upon specific assumptions and parameter values of the model underlying a country's economy ²⁵. The choice of regime therefore is a very delicate decision.

Most of the following studies on the topic applied *Poole's approach to the choice of exchange rate regime*. These applications have been refined and extended (e.g. altering the underlying model, refining the nature and source of the disturbances, and changing the objective function). The extension of the topic to intermediate exchange rate regimes was surely the most important one.

3.3. Middle-of-the-road proposals for exchange rate policy

a. Optimal exchange market intervention

Although a managed currency was already advocated by Keynes in 1923, it has been only in the late 1970s that *the discussion shifted from optimal exchange rate regime towards optimal exchange rate intervention*. The optimal exchange rate policy is one of searching for the appropriate mix of the fixed and flexible exchange rate regimes rather than one of choosing between complete fixity or complete flexibility of the exchange rate. A large literature on the optimal degree of discretionary exchange market intervention emerged starting with Boyer (1978), Henderson (1979) and Roper and Turnovsky (1980). The framework adopted in these studies is again the approach

²⁵ For a similar conclusion, see also Flood (1979).

developed by Poole (1970) in his analysis of the monetary instrument problem. A *monetary supply rule* is formulated that adjusts money in response to exchange rate movements²⁶. The exchange rate may be used as an information filter on shocks that impinge upon the economy²⁷. So, the monetary authorities may wish to buy or sell foreign exchange reserves, altering the domestic money supply, in order to stabilize output in the face of these shocks. In their analysis, Boyer, Henderson, and Roper and Turnovsky assumed that the price of domestic output remains fixed. The major conclusion of their analyses is that *pure regimes (i.e. complete fixity or complete flexibility of the exchange rate)* are optimal only in very special circumstances²⁸. For a study which departs significantly from the Boyer-Henderson-Roper&Turnovsky framework, see Frenkel and Aizenman (1982), who build upon the paper by Fischer (1976).

Boyer (1978) showed that in the presence of both domestic monetary and real disturbances, some degree of exchange market intervention is called for, with the exact degree of intervention being determined by the precise values of the stochastic and deterministic parameters. When shocks only derive from the money market, a fixed exchange rate regime is optimal. Conversely, economies which face shocks predominantly in the goods market can stabilize output more efficiently by pursuing complete exchange rate flexibility, at least when money demand is independent of the exchange rate. If not, then the authorities should lean with the wind (i.e. exaggerate the exchange rate movements). It is only in these very specific cases where

²⁶ By then, it was widely agreed that monetary policy should be conducted according to rules (see Sargent and Wallace (1975)).

²⁷ The papers on optimal intervention follow Kareken, Muench and Wallace (1973) who have shown in their work on optimal monetary policy for a closed economy that currently observable data provide information about the sources of shocks to the economy.

²⁸ This result is also obtained by Buiters (1977), who analysed intervention policy in terms of *discrete-time control theory*.

particular shocks dominate stochastic behaviour that completely fixed or flexible rates are warranted ²⁹.

Henderson (1979) explicitly considered a domestic bond that is imperfectly substitutable with foreign bonds. He distinguished between an *aggregates constant policy* and a *rates constant policy*. Under the former the money supply and foreign exchange reserves are kept unchanged at chosen values, while under the latter monetary and intervention operations are employed to keep the interest rate and the exchange rate constant at selected values. When shocks are real (i.e. aggregate demand or aggregate supply shocks), it is shown that an aggregates constant policy is preferable in that it leads to less variation in output than a rates constant policy. When, on the other hand, the economy is perturbed by financial shocks (i.e. disturbances in the money market or the bond market), a rates constant policy leads to less variation in output than an aggregates constant policy. Again it is not optimal to adopt either pure intervention policy when the economy is subjected to several different shocks. Notice that Henderson's results are similar to those of Boyer except that a wider range of disturbances is considered.

Another paper, written by Roper and Turnovsky (1980), again analyzed managed floating and received similar results to those of Boyer and Henderson. They also had an interesting discussion on how optimal exchange rate policy from the standpoint of domestic stabilization can possibly be aggressive to its neighbours to the extent that it violates the usual guidelines for international cooperation ³⁰.

²⁹ Notice that Boyer also considered intervention in the goods market as an alternative to intervention in the foreign capital market for influencing the exchange rate. The conclusions concerning optimal intervention are reversed if intervention takes place in the goods market. Pegging of the exchange rate by intervening in the goods market causes a fixed exchange rate regime to be optimal when all shocks occur in the goods market and a flexible exchange rate regime to be optimal when all shocks impinge upon the money market.

³⁰ For a discussion of guidelines for managed floating, see e.g. Mikesell and Goldstein (1975), Ethier and Bloomfield (1975) and Tosini (1977). This literature deals with constraints on market intervention to prohibit aggressive beggar-thy-neighbour exchange rate policies. Since the objective of such guidelines is quite different from the one of domestic

Frenkel and Aizenman (1982) extended the analysis of Fischer (1976) to managed floating³¹. Again, results clearly differ from studies following Poole's approach. Real shocks tend to raise the desirability of greater fixity of exchange rates, while monetary shocks raise the desirability of flexibility. The results are reversed since, as in Fischer (1976), output does not respond to price innovations.

Most of the subsequent literature on exchange rate policies was written by Turnovsky in his 1983a, 1984 en 1985 papers. Pilbeam (1991) provided an interesting survey of the literature on exchange rate management.

As we have seen before, the work of Boyer, of Henderson, and of Roper and Turnovsky was set in a fixed-price world. Turnovsky (1983a) allowed both prices and output to vary and also had shocks originating on the supply side. The conclusions on optimal exchange market intervention, not surprisingly, again depend on the nature of the shocks under consideration. If shocks originate mainly from the domestic *monetary sector*, intervention should be pursued as vigorously as possible. A perfectly fixed rate regime has the property of stabilizing output perfectly in this case³². If shocks only derive from the domestic *supply sector*, the authorities can stabilize output perfectly by adopting a policy of *leaning with the wind*³³. By exacerbating the depreciation of the

stabilization, it is not surprising that results of both directions of research are sometimes at odds with each other.

³¹ Frenkel and Aizenman (1982) conducted their analysis in terms of an index of managed float that clearly differs from a simple money supply rule involving the exchange rate. Their index gives the "ratio of actual exchange rate changes to the magnitude of those that would have materialized in the absence of any central bank intervention in the foreign exchange market" (p. 235). Cuddington (1991) clarified the relation between this index and the more usual policy measure of intervention.

³² The price level will be stabilized perfectly, too.

³³ There is a trade-off to be made, however, between output and price stability. If the sole objective of the authorities is price stabilization, they should opt for leaning against the wind, instead. Indeed, fixed exchange rates favour price stability (in Turnovsky (1983a) domestic prices are pegged in this case given the purchasing-power-parity assumption), while flexible exchange rates favour output stability. The leaning-with-

currency, the authorities are capable of stabilizing output perfectly as the increased demand resulting from the additional depreciation compensates for the fall off in output due to the supply shock. Pilbeam (1991) has shown that this result crucially depends upon the structural parameters of the economy. The leaning-with-the-wind proposal in Turnovsky (1983a) only holds when the money demand curve is steeper than the output demand curve (in a price-output diagram)³⁴. If the relative slopes are reversed, a negative supply shock leads to an appreciation of the currency. Only by a *reversing the wind policy* (i.e. by provoking a depreciation of the currency), the authorities are able to stabilize output perfectly³⁵. In fact, Pilbeam's conclusion on aggregate supply shocks was already arrived at in Weber (1981)³⁶. In a model similar to that of Pilbeam, Weber obtained the result that as a response to such shocks output variability will be larger, the steeper the slope of the aggregate demand curve. If the money demand curve is steeper than the output demand curve, the aggregate demand curve will have a steeper slope under fixed rates than under flexible rates. So, in this case flexible exchange rates are preferred. Fixed rates are preferred if the reverse holds. As these illustrations show, *structural parameters can be crucial for optimal exchange rate management* since by simply reversing the relative slopes we also reverse conclusions concerning the optimal policy.

Turnovsky (1984a,1984b) introduced the potentially impor-

the-wind proposal, therefore, is only appropriate if there is sufficient bias of the objective function in favour of output stability.

³⁴ In Turnovsky (1983a), purchasing power parity holds so that the output demand curve is a horizontal straight line. Its slope is therefore always smaller than the slope of the money demand curve. Notice also that Pilbeam's condition on the slopes is equivalent to whether the product of the price elasticity of goods demand and the income elasticity of money demand is smaller or greater than unity.

³⁵ Notice that, contrary to Turnovsky (1983a), fixed exchange rates favour output stability while flexible rates favour price stability.

³⁶ Similar to other studies, Weber also found that a fixed exchange rate is optimal when shocks occur only in the money market, while flexible exchange rates yield higher output stability with output demand shocks.

tant distinction between *unanticipated and anticipated disturbances* on the one hand, and *transitory and permanent disturbances*, on the other. Moreover, he analyzed the question of optimal intervention by means of a *monetary supply rule* based on contemporaneous information on financial and price variables. Such a rule allows the monetary authorities to respond not only to the exchange rate, but also to prices and the interest rate ³⁷. Disturbances which are unanticipated and perceived as being transitory are shown to be more difficult to stabilize. With disturbances of this kind no optimal rule will succeed in stabilizing output completely about its frictionless level. In all other cases, output may be stabilized perfectly by the use of well-specified rules.

Turnovsky (1985) considered optimal intervention by means of a monetary supply rule based on contemporaneous information on financial and price variables versus an adjustment rule based on past information on output ³⁸. He has shown that, insofar as stabilizing output is concerned, a rule based on past information on output can outperform optimal rules based on current market information on financial and price variables. This means that greater output stability can be achieved by using information on the past fluctuations of the economy, rather than obtaining contemporaneous data that provide information on shocks.

b. Optimal target zones

In a *pure managed float* the authorities attempt to influence the behaviour of the exchange rate without committing themselves to hold it within a prespecified band. A *target*

³⁷ In such a design of monetary policy, it is assumed that information on prices and the interest rate is quickly available, just as is information on the exchange rate.

³⁸ Turnovsky (1980) has shown that rules based on past information are effective in stabilizing output if the expected rate of inflation is conditioned on information available at time t , at which time the actual price level is observed. Sargent and Wallace (1976) had shown that such rules are ineffective if the expected rate of inflation is conditioned on information available at time $t-1$.

zone, on the contrary, allows a limited range of variation for the exchange rate around some reference rate. Under a target zone regime, the defense of the exchange rate becomes only an occasional problem rather than a continuous occupation. It is only recently that economists devoted widespread attention to target zones ³⁹. Among those advocating the target zone approach to exchange rate policy, Williamson is mostly mentioned (see Williamson (1985) and Miller and Williamson (1987)). His proposal for target zones aimed at preventing exchange rate misalignment between industrial countries. His arguments have been only verbal and informal. It has only been during the late 1980s that economists explicitly focused on modeling the exchange rate behaviour inside the zone (see Krugman (1991) ⁴⁰ and Miller and Weller (1991)). The crucial point in these papers is that the existence of the band and the credible commitment of the authorities to defend the exchange rate exert a stabilizing influence on the exchange rate even if there are currently no interventions ⁴¹.

There has been relatively little attempt to determine whether target zones or worse or better than other possible exchange rate regime in terms of their stabilizing properties. The literature on this subject falls into two types. The first originates with Krugman (1991) and is usually based on a simple reduced-form equation for the exchange rate, which is often called the *flexible-price monetary model*. The applicability of the Krugman model is severely limited due to the assumptions of price flexibility, full employment and purchasing power parity. The second type of target zone model

³⁹ Interest in target zone arrangements has grown since they have become increasingly important in Europe. The EMS covers nearly all EC countries, and the Nordic countries have self-imposed target zones for their currencies.

⁴⁰ The first version of Krugman's paper appeared three years earlier.

⁴¹ Basic target zone models assume full credibility of the exchange rate band and exclude the possibility of realignments (i.e. they only consider interventions at the margin). For an overview of extensions to these models (intra-marginal interventions and realignments of the margins), see Beetsma (1991).

uses the *sticky-price Dornbusch model* (as in Miller and Weller (1991)), which allows for sluggish nominal wage dynamics, transitory unemployment and imperfect substitution between home and foreign goods. The cost of greater realism is that explicit solutions to the model are no longer available. Since in Krugman the basic structure is too simple and in Miller and Weller it is too complex, both these models focus exclusively on only one source of stochastic shocks (a monetary shock and a shock to the price adjustment process, respectively). Recently, Sutherland (1992) presented a model which has more structure than the basic reduced-form approach to target zones (both aggregate demand and supply are explicitly modeled) but which is less complex than the sticky-price model (it contains no dynamic variables) so that a wider range of shocks can be considered⁴². Sutherland's analysis consists of the following results⁴³. A target zone tends to damp the effects of *monetary shocks* on output relative to a free float regime. However, a target zone is less effective than a completely fixed exchange rate at stabilizing output (as shown before, a fixed exchange rate has the property of eliminating the output effects of monetary shocks perfectly). For *demand shocks*, the effect of a target zone is to destabilize output relative to a free float, but to stabilize output relative to a fixed exchange rate. *Supply shocks* give rise to two cases (as is the case with continuous intervention, see Pilbeam (1991)). With the money demand curve steeper than the output demand curve (in a price-output diagram), a target zone tends to destabilize output relative to a free float regime. If the reverse holds, the existence of a target zone decreases the

⁴² The stochastic shocks in the target zone literature are all *Brownian motion processes* (i.e. continuous-time random walks). Assuming a Brownian motion makes it possible to solve analytically for the exchange rate and produces an intuitive appealing S-shape behaviour for the exchange rate within the target zone. The presence of the band and possible intervention by the monetary authorities drive the exchange rate away from the edges towards the center of the fluctuation band.

⁴³ These results are perhaps not surprising since for each shock the effects on output are equivalent to what arises under a continuous intervention policy (see before).

impact of supply shocks on output compared to a free float. Knowing the effect on output of different kinds of shocks, it is easy to draw some conclusions concerning the zone width. As the width of the target zone is reduced, so that the target zone becomes more like a completely fixed rate, the effect of monetary shocks on output is tempered, but the destabilizing effect on output caused by demand shocks is increased. So, if there are only demand shocks then a band of infinite width (that is a free float) is optimal; at the opposite extreme, when there are only monetary shocks, the optimal band width goes to zero. A narrowing of the target zone increases or decreases the impact of supply shocks on output depending on the relative slopes of the money demand curve and the output demand curve. Again, it can be concluded that neither a completely fixed regime (zero band width), nor a completely flexible regime (infinite band width) would be optimal in the presence of several shocks of different nature.

c. Some final notes on intermediate exchange rate regimes

As results from most studies show, if the economy is predominantly perturbed by *monetary shocks*, the desirability of exchange rate fixity becomes larger. On the other hand, the desirability of exchange rate flexibility increases if *real shocks* impinge on the economy (For *supply shocks*, however, no strong conclusions emerge). These results have been shown by various authors to be robust in a wide variety of alternative model specifications, involving specific assumptions concerning, for example, wage setting and intervention rules⁴⁴. Nevertheless, one should not expect to be able to derive simple and unambiguous conclusions concerning a country's optimal choice of exchange rate policy. The optimal choice of

⁴⁴ See ,e.g., staggered wage setting in Bhandari (1982) and the complex intervention rules in Turnovsky (1985). As noticed before, in Fischer (1976) and Frenkel and Aizenman (1982) the conclusions concerning monetary and real shocks are reversed.

an exchange rate regime does in general not correspond to the extremes of completely fixed or flexible rates. Indeed, for an economy *subjected simultaneously to two or more shocks*, it becomes troublesome when deciding on the appropriate degree of exchange rate flexibility. In order to decide, the authorities need very precise information, not only on the nature of the shocks but also on their relative magnitudes and covariances. When there are several shocks of different nature, there are two ways to achieve a compromise between the ability of fixing to deal with monetary shocks and the ability of floating to deal with goods demand shocks. Both *continuous intervention* (i.e. a feedback rule which ties monetary policy to the exchange rate) as well as a *target zone of finite non-zero width* indeed deliver a better stabilizing performance for output than either a completely fixed or a completely flexible exchange rate. The possibility to adopt superior policy responses (i.e. optimal intervention or optimal band width) for both options crucially depends on the information about the shocks available to the authorities.

A monetary authority aiming at completely neutralizing disturbances from various sources simultaneously needs to design a *complex monetary policy rule* that is not limited to respond to the exchange rate only. A continuous intervention policy can be designed to exploit the information contained in several observable market data (the price level and the interest rate e.g., as well as the exchange rate) which allows complete stability to be achieved in the economy. However, as shown by Pilbeam (1991, p.74-75) in an example, extracting information from contemporaneously observable data and using this to determine optimal policy responses turns out to be a rather complicated task. Trying to distinguish between different shocks by means of filtering financial and price data may not always be very clear, so the authorities may not be sure what shock impinges upon the economy at a given moment in time. This means it cannot always adopt an appropriate policy response to achieve complete output stabilization. The

authorities will require sufficient indicators to determine precisely the shock that perturb the economy. Again, Tinbergen's instruments-targets rule should be supplemented with a rule that *the number of independent indicators that trigger the intervention rule be equal to the number of possible shocks that impinge upon the economy*. As most writers on the topic admit, optimal intervention rules are often intractable expressions. Moreover, intervening all the time requires a huge amounts of costs compared to the target zone alternative. So, in practice, possibilities for the authorities to follow such complicated intervention rules are rather limited.

4. Wage indexation in the open economy

4.1. Wage indexation, exchange rate flexibility and macroeconomic stability

In this section, we shift focus to combining the issues considered in the previous sections. As we will see, each choice of an exchange rate regime has potential benefits and costs that depend on factors such as the shocks facing the economy and the form of wage setting within the economy. At the same time, the perceived exchange rate regime will feed back onto the way wages are formed.

a. Optimal exchange rate policy for a given degree of wage indexation

Marston (1982), Aizenman and Frenkel (1985a), and Pilbeam (1991) analyzed the choice between fixed and flexible rates subject to an exogenously given wage indexation rule. They assumed that *because of institutional or legal constraints indexation remains the same for different exchange rate regimes*. So, their concern is with optimal exchange rate policy given the structure of the economy, including the degree of wage indexation ⁴⁵. Wage behaviour is important to the choice

⁴⁵ Frenkel and Aizenman (1982) analyzed optimal exchange rate policy given the relative size of the traded goods sector to the non-traded goods sector. They showed that a high share of spending on traded goods (a high

between exchange rate regimes because it determines to what extent a change in the exchange rate also changes the relative prices of foreign and domestic goods ⁴⁶. It is primarily through changes in relative prices that exchange rates affect domestic output. In the well-known Mundell-Fleming studies both wages and prices were assumed constant ⁴⁷. Under this assumption any change in the exchange rate results in an equal change in relative prices. When wages are responsive to changes in the general price level, however, domestic prices respond indirectly to changes in the exchange rate.

Marston showed that, when there is *no wage indexation*, the effects of monetary and aggregate demand disturbances correspond to those reported in Mundell's study (1963) ⁴⁸. A monetary disturbance leads to a greater change in output under flexible rates (it has no effect on output under fixed rates). An aggregate demand disturbance changes output by less under flexible rates. When indexation is important, however, these familiar results can break down. The effect of the exchange rate on output depends crucially on the extent of indexation in the domestic economy. In the case of a monetary disturbance, there is no output change under fixed as well as under flexible rates if *indexation is complete*. This is because the effect of the disturbance fails to change the real wage. An aggregate demand disturbance results in output varying to the same extent under both regimes. The effect of indexation,

degree of openness) tends to increase the desirability of greater flexibility of exchange rates. This result seems in line with Tower and Courtney (1974).

⁴⁶ Sachs (1980) was the first to show that in an open economy with a floating exchange rate the familiar Mundell-Fleming ranking of fiscal and monetary policy is reversed when real wages cannot be altered by exchange rate movements.

⁴⁷ The Mundell-Fleming propositions about the relative effectiveness of fiscal and monetary policy under fixed and flexible rates can readily be transformed into statements about the effects of domestic aggregate demand and monetary disturbances. In the Mundell-Fleming model, fixed rates are preferable to flexible rates if monetary disturbances are important. This ranking is reversed when aggregate demand disturbances are important.

⁴⁸ The similarity with Mundell's results should not be surprising since labour contracting with no indexation fixes wages just as in Mundell.

therefore, is to blur the ranking of regimes, with full indexation eliminating the advantages or disadvantages of a particular regime. The more highly indexed the economy, the less difference the choice of exchange rate regime makes for output variation ⁴⁹. With such indexation, the choice between regimes must be made on other grounds such as price behaviour. Hence, this can be a good justification for incorporating price stability into the objective function of the authorities.

Aizenman and Frenkel examined the dependence of the optimal exchange rate regime on the *entire spectrum of possible degrees of wage indexation* ranging from no indexation to complete indexation in a model where purchasing power parity holds and where the economy is perturbed by an aggregate supply shock and a money supply shock. They concluded that under these assumptions a higher exogenously given degree of wage indexation results in a higher optimal degree of exchange rate flexibility ⁵⁰.

Pilbeam also considered the implication of wage indexation when a supply shock is impinging upon the economy ⁵¹. Wage indexation leads to a deterioration of output variability performance of both fixed and flexible rates as compared to the case of no indexation. The relative output variability under fixed versus flexible rates with wage indexation is even more unclear than in the case of no indexation. As discussed

⁴⁹ With respect to foreign disturbances it can be said that their effects on the domestic economy depend as much on foreign wage and price behaviour as domestic. If the rest of the world is fully indexed, flexible rates insulate the domestic country completely from foreign monetary disturbances. If the rest of the world is more highly indexed than the domestic country, then for high price elasticities, at least, a flexible rate dampens the output variation associated with foreign demand disturbances. Marston (1985b) showed that insulation can also be achieved with flexible rates if both the law of one price holds and the domestic country is fully indexed.

⁵⁰ For a similar conclusion, see Daniel (1985).

⁵¹ Contrary to Aizenman and Frenkel (1985a), Pilbeam did not assume purchasing power parity. It is seen that the slope of the output demand schedule becomes important when discussing indexation in the case of a supply shock.

in section 3.3.a of this review, with a supply shock impinging upon the economy it is necessary to distinguish between two cases, the case where the money demand schedule is steeper than the output demand schedule and the case where the reverse holds. However, with wage indexation it is now possible that in the former case fixed exchange rates may involve less output variability than flexible rates. Also for the latter case indexation may result in a reversion of the results with output variability now being less under flexible rates than under fixed rates.

b. Optimal wage indexation for a given exchange rate system

The above studies analyzed the optimal choice of exchange rate regime for a given degree of indexation. Other analyses recognized that the optimal degree of indexation depends on the prevailing exchange rate regime⁵². In a model where purchasing power parity holds, Flood and Marion (1982) and Aizenman and Frenkel (1985a,1986) stated that one cannot assume stability of structure when assessing the consequences of alternative regimes⁵³. They therefore assumed that *the indexation parameter is an endogenous variable that is set at its optimal value in response to the choice of exchange rate regime*. In turn, exchange rate regimes are compared according to their stabilization properties. These studies can therefore be considered as an extension of the familiar closed economy models developed by Gray (1976) and Fischer (1977a). Flood and Marion, and Aizenman and Frenkel showed that with supply and monetary disturbances complete wage indexation is always optimal for a fixed rate regime, while partial indexation is generally optimal for a flexible rate regime. In the absence

⁵² These analyses were extended by several other authors who showed that, in the open economy, the optimal degree of wage indexation depends on the degree of openness. Aizenman (1985a) showed that the more open the economy, the higher the optimal degree of wage indexation.

⁵³ This is known as the Lucas critique. It is wrong to assume the same fixed parameters when examining alternative policies. The parameters of the model vary themselves depending upon the policy option chosen.

of supply shocks, however, complete wage indexation is optimal irrespective of the chosen exchange rate regime. Moreover, a flexible rate regime is always preferable to a fixed rate regime if wage indexation is optimal. When there are no supply shocks, however, both regimes are equally preferable.

c. The joint optimization problem

Common to the above studies is the characteristic that the economy is either searching for the optimal degree of wage indexation under the assumption that the exchange rate system is exogenously given, or that it is choosing an optimal exchange rate system under the assumption that the degree of wage indexation is exogenously given. Several other authors analyzed *the effectiveness of exchange market intervention and wage indexation as joint policy instruments*. This means that the choice of an exchange rate regime influences the degree of indexation and consequently the slope of the economy's supply function. The converse is also true. The slope of the supply curve has important implications for how effectively various exchange rate regimes insulate output from disturbances. Both exchange market intervention and wage indexation are intended to reduce the effects of disturbances to the economy. Indexation impinges directly on the supply function of the economy and can therefore be viewed as being a *real form of policy intervention*. By contrast, exchange market intervention adjusts the money supply to the disturbances in so far as they are reflected by the exchange rate and is a *nominal form of policy intervention*. Turnovsky (1983b) and Aizenman and Frenkel (1985a) analyzed the joint use of wage indexation and exchange market intervention in the context of a pure intervention rule where the adjustment of the money supply is limited to the exchange rate. Some authors considered the link of exchange rate policy with wage indexation in the context of the broader problem of the design of optimal monetary policy (see Aizenman and Frenkel (1985b) and Turnovsky (1987)). In this case, intervention policy is considered as part of a more

general form of *monetary policy rule* with the monetary authorities adjusting the money supply in accordance with several financial and price variables, including e.g. prices and the interest rate as well as the exchange rate. The information set which the authorities have at their disposal when designing monetary policy, therefore, is assumed to be larger.

Turnovsky (1983b) has shown that a *particular choice of either policy instrument makes the other ineffective in stabilizing output*. If wages are fully indexed exchange market intervention becomes ineffective. Likewise, under a particular intervention rule (i.e. if the government intervenes in the foreign exchange market so as to render the excess demand for nominal money balances dependent upon only the real variables) wage indexation becomes impotent in influencing real behaviour. In his paper, Turnovsky is unable to stabilize output completely through indexation and exchange market intervention. The reason is that the number of disturbances exceeds the number of indicators that may form the indexation or intervention rules. With the exception of domestic supply disturbances, Turnovsky suggested that indexation policy should be directed toward the stabilization of output, while exchange market intervention should be directed at the attainment of price stability.

In his paper, Turnovsky only presented some alternative combinations of policies. However he did not derive a complete optimal stabilization package. In two papers by Aizenman and Frenkel (1985a&b) *the optimal choice of instruments is the outcome of a joint optimization problem*. In the first paper (1985a) they analyzed the problem in the context of a pure intervention rule, whereas the second paper (1985b) considered intervention as part of the optimal design of monetary policy. Aizenman and Frenkel found that optimal wage indexation and optimal monetary policy are perfect substitutes provided that their objectives are the same and that both are based on the same information. Given an optimal wage indexation rule, then

a monetary supply rule is redundant, and vice versa ⁵⁴. The optimal policy should either follow an *monetary policy rule* that is triggered by a sufficient number of independent indicators or a *wage indexation formula* that is not limited to respond only to changes in the price level. Only if one of these policies contain a number of indicators which exceeds the number of disturbances, then the loss of the distortion to the wage can completely be eliminated. If not, both wage indexation and monetary policy are necessary.

Turnovsky (1987) addressed the interdependence between optimal wage indexation and optimal monetary policy under alternative disturbances and information structures. As in his 1984-paper, he stressed the distinction between unanticipated and anticipated disturbances on one hand, and permanent and transitory disturbances on the other. It is shown that optimal rules that replicate the behaviour of a frictionless economy depend upon the relative availability of (incomplete) information to private agents and the public stabilization authority. In the case of unanticipated transitory disturbances, he found that the output of the frictionless economy can be replicated as long as private agents and the public authority have the same imperfect information. Inferior information available to the stabilization authority prevents it from being able to stabilize the economy perfectly. For unanticipated permanent disturbances, perfect stabilization can be achieved whether or not information is identical to private agents and the public authority. When disturbances are anticipated perfect stabilization obtains irrespective of whether the disturbances are expected to be temporary or permanent.

⁵⁴ This also means that there will be an infinite number of optimal combinations of indexation and monetary supply rules. Aizenman and Frenkel's redundancy propositions results from the fact that wage indexation and monetary policy have no independent effects on the losses caused by the distortion.

d. Using an indexation rule and a monetary policy rule as complementary or substitutable policies

The papers discussed above have clearly demonstrated that *the possibility to stabilize output depends critically on the precise form of the constraints that are imposed on both the indexation rule and the money supply rule*. In the absence of constraints on the degree of sophistication of these rules, full stabilization can easily be achieved, even with a single instrument. Indeed, *if one of both policies (the indexation rule or the monetary policy rule) contains a number of independent indicators which at least equals the number of shocks, there is no need to introduce the other*⁵⁵. In the case of a rich specification of the rules, the ultimate choice among the alternatives of a sophisticated wage indexation rule or a sophisticated money supply rule is likely to be governed by the costs and the difficulties of implementation associated with each alternative. The choice may also be influenced by external constraints (like the European Monetary Unification) and domestic institutional constraints (like institutional or legal wage indexation).

Departures from sophisticated rules can result in using both policies, however. With restrictions on the flexibility of policy instruments output variability cannot always be entirely eliminated (e.g. when wages are limited to respond to prices only or when monetary policy becomes identified with exchange rate management). *If the number of independent indicators governing policy is less than the number of shocks, then both wage indexation and monetary policy need to be used as part of an optimal package*. A sharp degree of specialization between the two policies becomes necessary. So, optimal monetary policy (or optimal exchange market intervention) should be used exclusively to offset particular disturbances,

⁵⁵ If, in addition, the authorities also wish to obtain an additional target (e.g. a reduction in the variance of prices), then the redundant indicators could be employed in the attainment of that target.

while optimal wage indexation should respond to other disturbances. Devereux (1988) was one of the first to show that in an economy with some instrument inflexibility specialization between instruments depends on the particular forms of the policy rules and, of course, on the type of disturbances.

4.2. More flexible indexation schemes for an open economy

Some authors writing on the indexation topic applied the debate concerning the appropriate degree of indexation on more flexible indexation schemes. Indexation of wages to several prices separately is a well-known principle. In the debate concerning the appropriate price against which to index, Marston (1984) and Turnovsky (1983b) allow for two alternative types of indexation: (1) *consumer price indexation*, where wages are tied to the general price level (which includes the foreign price and the exchange rate as well as the domestic price), and (2) *domestic price indexation*, where wages are tied to the domestic price alone ⁵⁶.

A well-known paper discussing the conditions under which indexation to a domestic price index is preferable to the traditional form of indexation to consumer prices is the one by Marston (1984). In his article, Marston showed that the results found in the Gray-Fischer studies of closed economies are modified by introducing the terms of trade into the economy. The desirability of indexing to a particular price differs according to how the terms of trade respond to the disturbances. In the presence of a *demand disturbance*, domestic price indexation is preferable to consumer price indexing. However, if the objective of indexation is to minimize deviations from output in a frictionless economy instead of deviations from output in a stationary equilibrium a mixed form of indexation

⁵⁶ Aizenman (1985b) analyzed a related question allowing wages to respond differently to the price adjustment of the non-traded and traded goods sector.

dominates either indexation rule alone. In the presence of a *supply disturbance*, indexing wages to the consumer price results in a smaller change in output than indexing to the domestic price both in terms of the variation from its stationary equilibrium level and in terms of the variation from the level it obtains in a frictionless economy.

Turnovsky (1983b) analyzed to choice of the optimal and appropriate price against which to index together with the optimal degree of exchange market intervention. For *demand disturbances* it is most satisfactory to index the wage fully to (and only to) the domestic price. Exchange market intervention can then be used to stabilize the domestic price. For *monetary disturbances* output can be stabilized either by fully indexing the wage to the domestic price or by pegging the exchange rate. The latter, however, is preferable since with full indexation exchange market intervention, which is needed to stabilize the domestic price, is rendered ineffective. Finally, wage indexation is ineffective as a policy rule stabilizing *supply disturbances*. Output needs to be stabilized by an appropriate intervention rule.

As these authors have shown, even in a more complex setting there does not exist an invariant indexation scheme that is optimal in all circumstances. A scheme taking into account a particular price index can be preferable for some disturbances while at the same time exacerbating the effects of other disturbances. Hence, when there is a variety of disturbances in the economy the indexation scheme must include both prices, the domestic price as well as the consumer price index, with the exact values of the indexation parameters depending on the relative importance of the disturbances.

5. Wage formation and the exchange rate regime: suggested directions for further research

This survey has generated some insights into the circumstances under which wage indexation and exchange rate flexibility are desirable for attaining output stability. Nevertheless, it is possible to raise some problems with the literature under investigation. In this final section we want to underscore the restricting role of simplifying assumptions most often used in macroeconomic models which are based on the articles of Gray, Fischer, Turnovsky, Aizenman and others, and which yield results that have heretofore been regarded as theorems with wide generality.

A first problem with most of the literature on wage indexation and exchange rate policy is that the process whereby wages are determined is only partially specified. Indeed, in the prevalent literature, almost all attention is placed on wage indexation, although wage formation is determined by several other relevant factors. It would therefore seem to be more desirable to consider a model which is more explicit about the wage determination process. By extending the indexation issue to the broader concept of *wage formation characteristics*, the debate on the optimal combination of wage indexation and exchange rate flexibility can be given an extra dimension. E.g., wage responsiveness to the unemployment rate, to labour productivity, and to income taxes and social security contributions have not yet been fully integrated into the theoretical literature on the interdependence between the labour market and the exchange rate regime ⁵⁷.

⁵⁷ For an analysis considering wage responsiveness to unemployment in combination with the exchange rate regime, see Van Gompel and Van Poeck (1992). De Grauwe (1992) shortly discussed labour productivity in the context of monetary integration in Europe. For some contributions concerning income taxes, see Lai and Chang (1989) and Bryson (1991).

A second remark concerns the *target zone literature*. First, it is not at all clear under what circumstances a target zone regime is preferred to a regime of continuous intervention, and vice versa. Second, in considering stabilization of the economy target zone models are mostly very brief on the supply side (which is mainly due to the complex analytical derivations). A more explicit formulation of ,e.g., the wage formation process in the target zone literature would open up a new area of research territory.

Another criticism of many of the papers in this survey is that the *choice of objective function* is restrictive. As mentioned in the introduction to this survey, most papers are conducted from the viewpoint of output stabilization. It can easily be argued, however, that different countries, even if they face similar shocks, may well require different degrees of wage indexation and exchange rate flexibility simply because their objectives differ. There are several factors other than the deviation of output from its frictionless level which should be taken into account in evaluating indexation and exchange rate arrangements. One important aim of policy, e.g., might be to reduce the variability of the price level. Although an extension of the objective function would surely give rise to more complexity, we see it as an necessity to investigate its implications.

Most of the literature dealing with the optimal combination of wage formation characteristics and exchange rate flexibility has concentrated on a single country. Less work has been done from a *multi-country perspective*, although this is the right way to approach the problem ⁵⁸. Indeed, the choices of countries to have more or less exchange rate flexibility are not independent ⁵⁹. In such a setup, it is not enough to

⁵⁸ See e.g. Argy et al. (1989).

⁵⁹ In this respect, we can note an important warning by Mundell (1969): In a world with n countries, only $n-1$ of them can pursue an independent exchange rate policy. Their exchange rates determine the rate

consider what policy regime is optimal for a particular country; one must also consider the interaction among the regime choices of various countries. Under what conditions do different countries have a common interest in either a floating or a fixed exchange rate, and under what conditions are there conflicts of interest? It can then be examined what is the optimal degree of exchange rate flexibility between a group of countries. For some pioneering work in a multiple-country setting see e.g. Canzoneri (1982), Henderson (1984), Marston (1985a) and Kenen (1989).

Finally, we want to stress the importance of empirical applications. To my knowledge, *practically applicable policy recommendations that have a solid empirical foundation* are very rare. The literature on the optimal combination of wage indexation and exchange rate flexibility has certainly clarified a number of important issues. Nevertheless, it clearly formed the basis for a complex taxonomy of shocks, economic structure, and policy that is very difficult to implement in practice. Recommendations are likely to vary from case to case and to be excessively complicated. Not surprisingly, we do not expect extensions to the existing literature, in the way mentioned above, to reduce this abundance of possibilities. However, once the underlying parameters of the model are known, this means empirically estimated, policy recommendations can much easier be arrived at. It then becomes highly interesting to ask to what extent *the optimal policies or characteristics could have improved the macroeconomic developments* of the industrial countries during the last two decades. Also, the issues discussed in this survey can be relevant in the debate on the formation of a European Monetary Union. Two key issues are *the desirability and the feasibility of such a union*. To what extent will there be a need to reform the labour market?

for the remaining country.

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