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The changing role of foreign labor and female participation: Impacts on wage-price dynamics and unemployment in Switzerland

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1 Introduction

One of the models used at Swiss National Bank in the monetary decision process is a quarterly medium-size structural model of the Swiss economy.[1] In its present version, the model has 30 behavioral equations that may be assigned to an aggregate demand block, a supply block and a monetary block. This model, described in some detail in Stalder (2001a, 2001b) and henceforth referred to as the *macromodel*, forms the basis of the analysis of this paper. The model has *Keynesian* properties in the short run but converges to a *classical growth path* in the long run. Real GDP, as determined in the short run from the demand side as the sum of the components of aggregate demand, is confronted in the supply block of the model with capacity output. The production function underlying the definition of capacity output also establishes a link from the goods to the labor market, where employment depends in a "Beveridge curve"-type approach on labor demand, labor supply and structural mismatch. Inflation is driven by the demand/supply-ratios in the goods and labor market. Due to inertia in the formation of wages and prices, aggregate demand and monetary variables play an important role in explaining short-term fluctuations of economic activity. In the long run, however, the development of GDP is fully determined by the supply side of the economy so that any overhang in the growth of nominal demand over the real growth potential is absorbed by inflation.

The pros and cons of such a *structural modeling approach* in comparison with alternatives like VAR and SVAR models have been widely discussed in the literature and are well-known by now.[2] One of the advantages of the structural approach is certainly the possibility to work out the implications of *structural or institutional changes* with regard to the aggregate behavior of the economy. Conversely expressed, if a significant change in the co-movement of macroeconomic variables is observed, a model of this type may be helpful in locating the underlying reason. For example, if inflationary pressures remain surprisingly weak in a situation of low unemployment and high capacity utilization, a careful analysis of parameter stability may show whether this is due to faster technical progress, reduced mismatch in the labor market or stronger competition in product markets. Of course, carrying out this kind of analysis in practice is not always easy.

This paper deals with *two examples of structural changes* in the Swiss economy that affect the relationship between wage-price formation and unemployment and thus are relevant in a monetary policy framework centered on an inflation forecast:

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[1] The monetary decision process at Swiss National Bank and the suite of models used in that process are described in Jordan and Peytrignet (2001).

[2] For an assessment from the perspective of a central bank, see Bank of England (1999).

- First, the paper presents empirical evidence for a *reduced cyclical flexibility of labor supply*, due to a changed composition of the foreign work force as well as a changed behavior of (married) women, and analyzes the implications with respect to the dynamic responses of the economy to a demand shock.
- Second, the paper offers a view about how the supply side of the Swiss economy might be affected by one aspect of the *bilateral agreements* with the European Union, namely the provision of *free movement of labor* between the EU and Switzerland, which became effective in June 2002.

While the first issue can be analyzed empirically on basis of historical data, the second one remains largely theoretical and somewhat speculative as it addresses the implications of an institutional change that are not yet observable. In both cases, however, the resulting changes in the economic structure affect the interplay of macroeconomic variables substantially and thus - if not taken into account in the model - would give rise to wrong inflation forecasts and inappropriate monetary policy decisions. The remaining part of this introduction gives some background information about the two examples of structural change.

Reduced cyclical flexibility of labor supply

Unemployment in Switzerland, which was practically absent in the 1970's and 1980's, has increased sharply in the recession of the early 1990's. The official unemployment rate rose from 0.5% in 1990 to an unprecedented level of about 5% in 1993. It stayed more or less that high until 1998, when a marked recovery set in that brought unemployment down to 1.7% by the year 2000. Since then, the unemployment rate has increased to 2.8% by mid-2002. Of course, these numbers are still impressively low as compared to most other countries. On the other hand, considering that earlier economic downturns produced peak unemployment rates of only about 1 percent, it is also clear that things have changed quite strongly over time. In this connection the following two questions arise: (1) Which were the characteristic features of Switzerland's labor market that kept unemployment so low in the past? (2) Which of those factors have changed over time and what are the implications for wage-price dynamics and the functioning of the Swiss economy in general?

An important consideration in this context is the large number of *foreign workers*, accounting for about 20% of the total labor force in Switzerland. Whereas earlier recessions were accompanied by a substantial net-outflow of foreigners, such a cyclical flexibility of labor supply could no longer be observed more recently. The reason for this is that foreigners, who originally entered Switzerland with temporary work permits, have meanwhile in their majority become permanent residents. As such, they acquired the same legal status on the labor market as Swiss citizens, in particular with respect to unemployment insurance. Moreover, one may assume that they developed stronger links with Swiss society in general. These changes are likely to entail a reduced buffer role and should be reflected in wage formation and the associated dynamics of employment and unemployment: During past cyclical troughs, one expects to observe a quick fall in labor supply and correspondingly only a limited increase in

unemployment. This, however, is also likely to give rise to relatively weak downward pressure on wages and a delayed subsequent recovery of employment. In contrast, under the regime of a reduced buffer role of foreign labor, a recession can be expected to entail a bigger rise in unemployment, hence more downward pressure on wages and therefore a quicker recovery of employment to the pre-recession level. Apart from the differences in wage moderation, one may also argue that rehiring people from the domestic unemployment pool is less costly than recruiting people from abroad. In the extreme, one might postulate kind of a hysteresis effect in the sense of insider-outsider theory.[3]

Quite similar effects can be expected from the fact that the *labor force participation of women* has become more permanent over time. In earlier decades, married women retreated in significant numbers from labor supply in times of unfavorable labor market conditions. This can be viewed as a "discouraged worker" mechanism that also tended to limit the incidence of excess supply in the labor market but a the same time reduced downward pressure on wages and contributed to a higher persistence of low employment after cyclical troughs. To the extent that the integration of women in the labor market has become more permanent, one expects to see larger swings in the unemployment rate on the one hand and quicker recoveries of employment to pre-recession levels on the other hand.

Bilateral agreements with the EU on free movement of labor

Immigration into Switzerland has changed its character substantially in the recent past. Whereas the last big wave of immigration in the second half of the 1980's still consisted to a large part of less-qualified workers, the labor shortage of the years 2000/2001 was concentrated in the qualified segments of the labor market and thus attracted foreigners with above-average levels of qualification. The bilateral agreements with the EU that became effective in June 2000 should facilitate this type of immigration because they eliminate the insecurity and nuisance associated with the need to renew work permits every year. In the discussion preceding the referendum on the bilateral agreements, latent fears in the population of mass immigration from the EU were deemed unjustified by Swiss government and most political parties. Rather, it was argued, the treaty should facilitate "selective" immigration of "specialists", allowing firms to fill exactly those job vacancies for which search among Swiss residents proved unsuccessful. This view of the consequences of the agreement, although it may be challenged for several reasons, is adopted in the analysis of this paper. In other words, it is taken for granted that the treaty does not lead to a general increase in labor supply with depressing effects on real wages but rather to a situation with reduced structural mismatch on

[3] Insider-outsider theory claims that unemployment persistence is due to the fact that unemployed workers loose insider status and hence their moderating influence on the outcome of wage negatiations. If the insider-outsider theory is empirically relevant, it should certainly apply to the distinction between domestic and foreign workers. Labor unions and society in general are likely to care less about employment of foreigners than employment of natives, the more so if the dismissed foreigners have already left the country.

the labor market. This view implies - in terms of the *Beveridge curve* - that a certain level of unemployment combines with less vacancies and therefore - in terms of a *Phillips curve* - less upward pressure on wages and prices.

The labor market specification of the macromodel lends itself quite naturally to capture such a mismatch-reducing effect of immigration. The relationship between labor demand, labor supply and actual employment is modeled on basis of the notion that the aggregate labor market consist of a multitude of "micro markets" which are characterized by different demand/supply ratios. The variation in this ratio across micro markets measures the extent of structural mismatch. In each period, while some micro markets are excess demand others are in excess supply, in varying proportions depending on the state of the business cycle as reflected in the aggregate demand/supply ratio. In the first (second) subset of micro markets, employment is supply-determined (demand-determined). Accordingly, in the first subset of micro markets firms recruiting workers are confronted with "labor shortages", whereas the second subset of micro market is characterized by unemployment.

Under the provision that firms give priority to job applicants that are already in the country (if suitable for the job), additional immigrants from the EU enter only those micro markets that are in excess demand. This reduces the number of vacancies and allows firms to rise output. The subset of micro markets in excess supply is not directly affected. However, by removing labor shortages in the subset of micro markets in excess demand, immigration may even reduce unemployment in the subset of micro markets in excess supply. Hence, by alleviating the structural mismatch between labor demand and labor supply, the bilateral agreements can expected to lead to a situation with higher employment and lower equilibrium unemployment, i.e. a lower threshold under which unemployment entails accelerating inflation.

The remainder of the paper is organized as follows. *Section 2* describes the model, with emphasis on those parts that are central to the two types of structural change under discussion. *Section 3* presents the empirical evidence for a reduced cyclical flexibility of labor supply and works out - by means of shock simulations - the consequences of this change for the aggregate behavior of the economy. The potential impact of the bilateral agreements on equilibrium unemployment is analyzed in *Section 4. Section 5* summarizes the paper and draws some conclusions.

2 The model

Both types of structural changes discussed in this paper affect the supply side of the economy. Although interactions with the demand side are important, the detailed specification of aggregate demand and monetary relations in the *macromodel* would not be expedient for the purpose of this study. The analysis of the implications of the structural changes on the supply side would be conditional on many assumptions in the big rest of the model, like the reaction of

monetary policy and the induced behavior of the exchange rate. To make the discussion more transparent, the model actually used in this paper is therefore a *stripped-down* version of the macromodel. It consists of the complete *supply block* of this model, supplemented with a more *stylized representation of aggregate demand*. As the model's supply block can be concentrated into a relationship between the aggregate price level p (GDP deflator) and aggregate output Y (real GDP) in the sense of an upward sloping short-run supply curve, the model can be closed in a very simple way by taking nominal GDP Y^n as exogenously given. Through the definition $Y^n = Y \cdot p$, this is amounts to the assumption of a downward sloping aggregate demand curve with a price elasticity of minus unity,

$$Y = Y^n p^{-1}, \tag{1}$$

where Y^n (or money supply in the background) defines the exogenous position of the demand curve in (Y, p)-space. The detailed specifications of aggregate demand and the monetary sector in the macromodel indeed imply such a relationship between the aggregate price level and output, although not necessarily of this simple form with an elasticity of minus unity.

We now turn to a detailed discussion of the supply block. The equations for firms' decisions on investment, production capacity and prices are specified in the spirit of a *vintage production function*, i.e., the assumption that 'machines' can be designed to combine with an optimal amount of labor input prior to their installation but that factor proportions remain fixed thereafter. On the assumption of *monopolistic competition in the product market*, the problem of the firm then is to choose on each investment vintage the cost-minimizing factor mix, to pursue an optimal policy of replacing old investment vintages by new equipment and to adjust production capacities, output and prices in response to changes in goods demand and factor costs.

The evolution of capacity output YC_t and capacity labor demand LC_t (i.e., labor demand corresponding to full utilization of the available equipment) over time is described by the following two equations:

$$YC_t = S_t\, YC_{t-1} + B_t I_t \tag{2.1}$$

$$LC_t = S_t\, LC_{t-1} + C_t I_t \tag{2.2}$$

S_t is the share of surviving equipment from the previous period (i.e. 1- S_t is the scrapping rate). B_t is capital productivity and C_t is labor intensity on new equipment and I_t. is gross investment of the period. Hence $B_t I_t$ is capacity added by vintage t and $C_t I_t$ is the corresponding labor requirement. Assuming (for vintage t) a Cobb-Douglas production function with labor-augmenting technical progress q and labor share a, B_t and C_t are obtained as

$$B_t = B_0 q_t^{-a} e^{qa\,t} \qquad \text{and} \tag{3}$$

$$C_t = C_0 q_t^{-1} \qquad \text{where} \quad q_t = w_t / v_t \tag{4}$$

is the ratio of wages to the cost of capital.

The *expected* long-term growth rate of the factor cost ratio theoretically also plays a role in (3) and (4) for the following reason. The replacement of existing by new equipment is determined by a comparison of production costs. On existing vintages, the factor input proportions are fixed and capital costs are "sunk". Existing vintages get thus replaced as soon as the associated unit labor costs exceed total unit costs on new equipment (scrapping rule). Hence, if wages are expected to increase strongly in relation to capital costs, the prospective lifetime of new equipment shortens and firms shift to a more capital-intensive expansion path, i.e. they choose lower B_t and C_t. Without such a shift, the prospective lifetime would obviously shorten more. In specifications (3) and (4), these considerations are neglected or, put differently, it is assumed that the *expected* long-term growth rate of the factor cost ratio q_t is constant. This may be justified by noting that the logarithm of q_t can be represented empirically as a random walk with drift, implying that the innovations of the process affect the current growth rate of the factor price ratio but leave its expected long-term growth rate (drift term) unchanged.[4]

With respect to the scrapping decision, it is however not only the expected long-term but also the known *actual* growth rate of the factor price ratio that matters. Old equipment is typically more labor intensive than new equipment. Therefore, if wages increase strongly in relation to capital costs in a certain period, a larger share of existing equipment will loose its competitiveness and get scrapped. A pragmatic specification that reflects these considerations is

$$S_t = (1-d)\left[\frac{q_t}{q_{t-1}\exp(b)}\right]^{-x} \quad , \tag{5}$$

where b is the average growth rate of q_t (drift term of the above-mentioned random walk), d is the long-term normal scrapping rate and x is an empirical parameter that measures the negative impact of the growth rate of q_t on the share of surviving equipment, S_t.

Investment behavior is specified on basis of the same theoretical considerations. According to (2.1), if B_t and S_t are low (because of a high/fast increasing q_t), a larger volume of new investment I_t will be needed to expand production capacity from YC_{t-1} to YC_t. In fact, the investment equation can be derived on basis of (2.1) by replacing YC_t by some concept of desired capacity and solving for I_t, as shown below.

On the assumption of monopolistic competition in the goods market, firms set the *price* as a profit-maximizing markup over marginal costs *MC*. These can be defined either as *total unit costs on new equipment* or as *unit labor costs on the oldest equipment*. The two concepts are equivalent in equilibrium due to the *scrapping rule*, saying that old vintages get replaced as

[4] For a more detailed discussion see Stalder (1994).

soon as the associated unit labor costs exceed total unit costs on the most recent vintage. The *normal markup price* of a firm can thus be written as[5]

$$\bar{p}_t = \left(\frac{h}{h-1} \right) MC_t \ , \tag{6.1}$$

where h is the price elasticity of the firm's demand curve and marginal costs are defined, on basis of the Cobb-Douglas vintage production function, as unit cost on new equipment,

$$MC_t = w_t^{a} \, v_t^{1-a} \, e^{-qa\,t}, \tag{6.2}$$

where a is the labor share and q is the rate of labor-augmenting technical progress.

Desired production capacity is given by demand at $\bar{p}$, $YD(\bar{p})$. In the short run, however, the available set of vintages may place an upper bound on output, giving rise to two possible *regimes* of the firm:[6]

1. If a firm faces a demand curve which, at the normal markup price $\bar{p}$, exceeds capacity output YC, it will produce at full capacity ($Y = YC < YD(\bar{p})$) and raise the price above $\bar{p}$ ($p > \bar{p}$) in order to choke off excess demand. Moreover, effective labor demand LD will correspond to capacity labor demand LC in this case.
2. If demand at $\bar{p}$ falls short of capacity output YC, the firm's output level is constrained by demand ($Y = YD(p) < YC$) and the optimal price p is practically equal to $\bar{p}$. In this case, effective labor demand LD is reduced in relation to capacity labor demand LC.

Figure 1 gives a graphical illustration. The line AB shows unit labor costs on existing equipment (ULC) times the markup factor m as we move from new to old equipment. The intersection point B with the horizontal line at $\bar{p}$, given by the markup over unit cost on newest equipment (UC), defines total production capacity. This is so because, according to the scrapping rule, ULC on oldest equipment must equal UC on the most recent equipment. The figure shows three possible positions of the demand curve. In case of YD_0 the firm is in equilibrium in the sense that demand at $\bar{p}$ is just equal to available capacities. In case of YD_1 (regime 1) the firm is capacity-constrained. In the short-run, it raises the price to point C in order to choke off excess demand. In the long-run, it extends capacities through investment to point E. In case of YD_2 (regime 2) the firm is demand-constrained. Available capacities remain partly idle due to insufficient demand.

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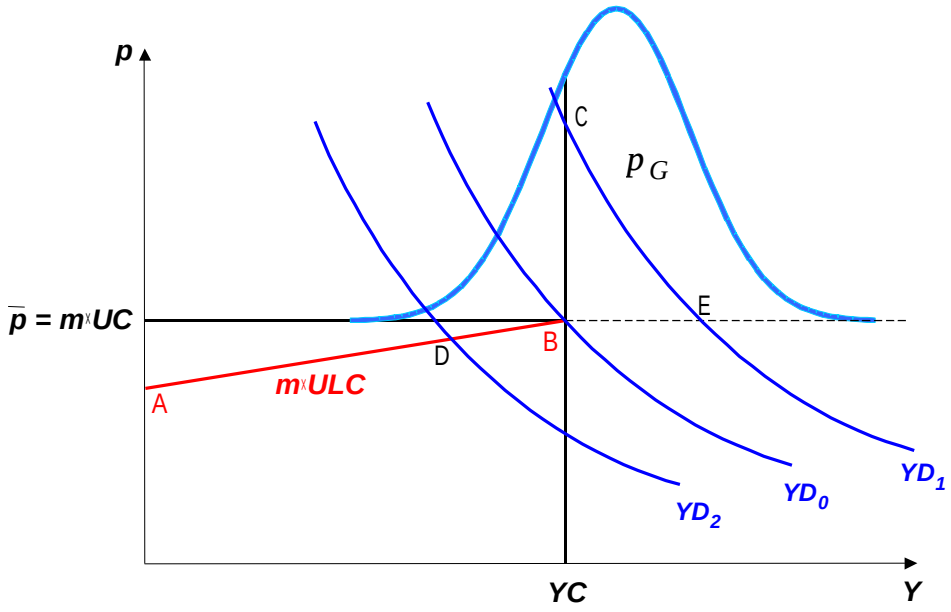
[5] The term "normal" is maybe somewhat misleading. More precisely, $\bar{p}$ is the optimal price neglecting capacity constraints or - expressed differently - the *long-term* optimal price since in the long run firms tend to bring capacities into line with demand. The effect of short-run capacity constraints on the actual price will be introduced below.

[6] In the following equations, the time subscripts are omitted.

Figure 1: Demand and capacity-constrained firms



This empirical relevance of this framework - which is similar to the so-called "disequilibrium" approach of Malinvaud (1980), Benassy (1986), Sneessens (1990) or Drèze and Bean (1990) - shows up in the fact that it establishes a straightforward link to *business survey data*: Firms reporting capacities as being "too small" (too large) indicate to be in regime 1 (regime 2). For a distribution of demand curves as shown in Figure 1, the proportion of firms reporting capacities as being "too small" would be about 70%. In a recession, for instance, the distribution will shift to the left, producing a declining proportion of capacity-constrained firms.

A convenient way to transpose this micro model to the *aggregate level* has been proposed - in a related context - by Lambert (1988). Assuming that the ratio $YD(\bar{p})/YC$ is *log-normally* distributed in the population of firms and that the output level of each firm i is given by the *minimum* of the two possible constraints, i.e.

$$Y_i = \min\left(YC_i, YD(\bar{p})_i\right) , \tag{7.1}$$

the aggregate relationships can be approximated by

$$Y(1-p_G)^{-k} = YD(\bar{p}) \tag{7.2}$$

$$Yp_G{}^{-k} = YC , \tag{7.3}$$

where p_G is the proportion of firms reporting capacities as "too small" (regime 1). Equations (7.2) and (7.3) define a one-to-one mapping from the two latent variables $YD(\bar{p})$ and YC to the two observable variables Y and p_G. In order to see how this mapping works, it is best to divide (7.2) by (7.3), which gives a logit-type equation for p_G:

$$\left(\frac{p_G}{1-p_G}\right)^k = \frac{YD(\bar{p})}{YC} \tag{7.4}$$

According to (7.4), the *regime mix* (p_G, 1-p_G) is endogenously determined in the model by the aggregate demand/capacity ratio. The "curvature" of this relationship depends on parameter k. If we let $YD(\bar{p})$ increase in relation to YC, p_G converges to an upper bound of 1 ("all" firms are capacity-constrained). In such a limiting situation, Y according to (7.3) tends from below to YC, i.e., aggregate output corresponds to aggregate capacity. In figure 1, this corresponds to a shift of the *YD*-distribution to the right. If we let $YD(\bar{p})$ decrease in relation to YC (shifting the distribution in figure 1 to the left), then p_G according to (7.4) converges to a lower bound of 0 ("all" firms become demand-constrained). So in the limit Y according to (7.2) gets bounded from above by $YD(\bar{p})$. Aside from these limiting situations, actual output Y is always smaller than YC and $YD(\bar{p})$, increasingly so for large values of k. This parameter can be viewed as a measure of *mismatch* between the micro distributions of aggregate demand and capacity. More precisely, it measures the dispersion of $YD(\bar{p})/YC$ in the population of firms. In figure 1, a smaller value of k would be reflected in a narrower *YD*-distribution, implying a quicker movement of p_G from 0 to 1 if the aggregate demand/capacity ratio increases and thus a quicker change from predominantly demand-constrained to predominantly capacity-constrained situations.[7]

One should note here that the definition of *capacity output* in this model differs from the more commonly used concept of *potential output* in two respects. First, capacity output acts as a strict *upper bound* for actual output ($Y \leq YC$). In this sense, the output gap is never positive, whereas potential output as usually defined is output at a normal utilization rate so that the output gap becomes positive in boom periods. Second - and also in contrast to the usual concept of potential output - capacity output refers to *technical capacities* only. The tension situation on the labor market is taken into account separately, as shown below.

On the *labor market*, the aggregate relationships can be formalized in a similar way. As just outlined, in capacity-constrained firms (regime 1, proportion p_G) we have $LD = LC$ while in demand-constrained firms (regime 2, proportion 1-p_G) we have $LD < LC$. At the aggregate level, this *"Keynesian" spillover* from insufficient goods demand to effective labor demand can be represented by

$$LD = LC p_G^{\,k} \ , \tag{8}$$

where *LC* is given by (2.2). Apart from the limiting situation where p_G tends to 1 (i.e., as soon as some firms are demand constrained in the goods market), effective labor demand *LD* falls short of capacity labor demand *LC*. To allow for short-term labor hoarding, p_G is expanded into a lag structure in the empirical model.

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[7] For a more rigorous derivation of these aggregate relationships see Stalder (1991).

In analogy to the goods market, it is assumed that aggregate labor demand and labor supply are distributed over a continuum of micro markets. These micro markets are taken to be narrowly defined and homogeneous, so that a coexistence of unemployment and vacancies can be excluded. Hence, employment at the *micro level* is given by the minimum of demand and supply:

$$L_i = \min (LD_i, LS_i) \; . \tag{9.1}$$

However, on the assumption that ratio LD_i/LS_i is distributed log-normally across micro markets, excess demand regimes and excess supply regimes always coexist at the *aggregate level*, in varying proportions depending on the aggregate ratio *LD/LS*. Aggregate employment *L* is determined along with p_L, the proportion of micro labor markets in excess demand, by the following two equations:

$$L(1-p_L)^{-u} = LD \tag{9.2}$$

$$Lp_L^{-u} = LS \tag{9.3}$$

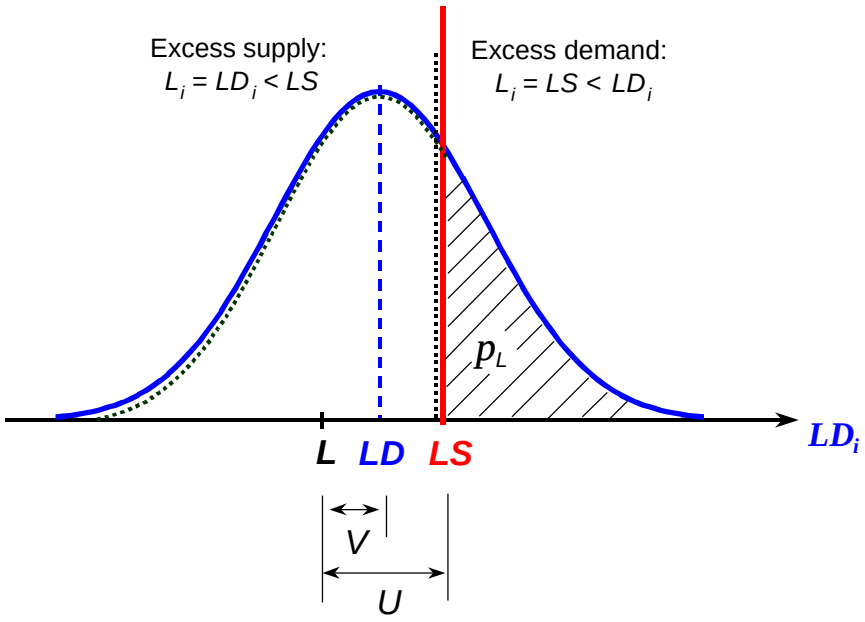
The proportion p_L is an endogenous variable of the system (as is p_G on the goods market) and measured empirically by the percentage of firms reporting "labor shortages" in business surveys. Dividing (9.2) by (9.3) one obtains

$$\left(\frac{p_L}{1-p_L}\right)^u = \frac{LD}{LS} \quad , \tag{9.4}$$

saying that p_L moves from a lower bound of 0 to an upper bound of 1 as *LD/LS* increases. As p_L approaches 1, employment *L* according to (9.3) tends from below to *LS*. Conversely, if p_L approaches 0, *L* becomes fully demand-determined in (9.2).

To illustrate things graphically, *Figure 2* makes the simplifying assumption that the micro labor markets are all identical with respect to *LS* and differ only with respect to LD_i. In the situation shown in the figure, a share p_L of about 30% of micro markets would be in excess demand. On those micro markets, employment is constrained by labor supply. The distribution of employment thus is censored at *LS*, with the whole mass of the LD_i-distribution to the right of *LS* concentrated into *LS*, as visualized by the dotted lines. The mean of this distribution defines average (or aggregate) employment *L*, which is somewhat lower than *LD*, the mean of the LD_i-distribution. The difference between *LD* and *L* is the number of vacancies *V*, the difference between *LS* and *L* is unemployment *U*. It is easy to see that shifts of the LD_i-distribution to the left (recession) and the right (boom) produce a behavior of *L* and p_L corresponding to what equations (9.2) to (9.4) imply.

Figure 2: Excess demand and supply the labor market



The *unemployment rate* can be expressed as

$$URATE = 1 - L/LS = 1 - p_L^{\,u} . \qquad (10.1)$$

If $LD = LS$, we have $p_L = 0.5$. This can be regarded as an aggregate equilibrium. The associated unemployment rate (*structural rate of unemployment at equilibrium*) is

$$SURE = 1 - 0.5^u . \qquad (10.2)$$

SURE is an increasing function of parameter u, which can be viewed as a measure of demand/supply 'mismatch' (dispersion of the demand/supply ratios across micro labor markets), as visualized by the width of the LD_i-distribution in figure 2.[8]

Aggregate *labor supply* in (9.2) is explained by the following equation:

$$LS_t = c_0 LFA_t \left(\frac{w_t}{pc_t} \right)^{c_1} e^{c_2 t} \quad , \qquad (11.1)$$

w_t / pc_t is the real consumer wage, t is a time trend and LFA_t is a construct for the potential labor force that is *currently active*. This active labor force is defined as

$$LFA_t = LF_t^{\,1-W} L_{t-1}^{\,W} \quad , \quad 0 \le W < 1 \, , \qquad (11.2)$$

[8] With regard to the SURE-concept the model of this paper is quite similar to the country models presented in Drèze and Bean (1990).

where LF_t is the *potential labor force* (number of residents in the age range 20 to 64) and L_{t-1} is actual employment in the previous quarter. (11.2) can be viewed as kind of an 'entry-exit' function in the sense of *insider-outsider theory* (Lindbeck and Snower, 1987) or as a *discouraged worker mechanism*. Parameter w measures the cyclical flexibility of labor supply or - in other words - the speed by which labor supply adjusts to past movements in actual employment. More sophisticated versions of labor supply equations with a distinction between permanent and transitory real wages and intertemporal substitution in response to the transitory wage component have been tried out but did not prove successful empirically.

Equations (7.2)-(7.3) for the goods market and equations (9.2)-(9.3) for the labor market can be regarded as *transformation equations*, linking latent demand and supply variables on the right-hand side with observables (actual market transactions and survey answering proportions) on the left-hand side. The convexity of these mappings depends on the two mismatch parameters, k and u respectively. Small values of k and u imply a quick transition from almost entirely demand-determined to almost entirely supply-determined situations as the aggregate demand/supply ratios moves from below through 1. The mismatch parameters are estimated jointly by maximum likelihood along with the behavioral and technology parameters of the supply block. For instance, specification (2) for capacity labor demand *LC*, with *C* and *S* replaced by (4) and (5) respectively, is substituted into (8) and from there - augmented by a multiplicative lognormal error term ε - into (9.2), which establishes then the mapping to observed employment *L* and the regime proportion p_L. We thus get an econometric equation that looks like

$$L(1-p_L)^{-u} = LD = \overline{LD}(...)\ e^{e} \ ,$$

where $\overline{LD}(\ldots)$ involves several explanatory variables and parameters. An analogous procedure is applied to the supply side of the labor market: Equation (11.1) with LFA_t replaced by (11.2) is augmented by an error term and mapped via (9.3) on actual employment and the regime proportion p_L. Similarly, on the supply side of the goods market, specification (2.1) for *YC* with B_t and S_t replaced by (3) and (5) is substituted into (7.3). With respect to the demand side of the goods market, however, it seems reasonable to assume that firms in excess demand at $\bar{p}$ raise the price enough to eliminate excess demand. This implies $Y = YD(p) < YD(\bar{p})$, i.e. goods demand at the *actual* price *p* is directly observable in form of actual market transactions (no "rationing" of aggregate demand). Note, however, that $YD(\bar{p})$ does not become redundant in the model since it plays a role in the price setting and investment decision of firms, as shown below.

When estimating this part of the model, one has to take into account - first - that the model is highly *nonlinear* and involves *simultaneous* endogenous variables. Second, there are several *cross-equation restrictions*. For example, the scrapping parameters (d and x), the mismatch parameters (k and u) and the technology parameters (a and q) are all cross-restricted between equations. Third, since the same theoretical specifications show up at different places in the model, *cross-correlated error terms* must be expected. For all these reasons, estimation by

maximum likelihood is advisable. In the framework of this estimation procedure, the mismatch parameters k and u in the transformation equations are determined - somewhat loosely stated - such that the model reproduces the actual developments of Y, L, p_G and p_L over time as closely as possible.

For didactic reasons we have neglected so far the fact that firms which are unable to fully realize their labor demand will have to revise their production plan. Put differently, actual output Y may fall short of capacity output YC not only because of insufficient goods demand but also because of *insufficient labor supply*. Hence, at the micro level, equation (7.1) must be replaced by

$$Y_i = \min\left(YC_i, YD(\bar{p})_i, YS_i\right) \quad , \tag{12.1}$$

where YS_i is the constraint on output resulting from a potential labor supply shortage.

In order to derive the aggregate counterpart of (12.1), note that the extent to which actual employment falls short of labor demand is measured in (9.1) by the term $(1-p_L)^u$. Hence, assuming that the *spillover* on goods supply is proportionate to the rationing of labor demand, the transformation equations for the goods market, (7.2) and (7.3), may be extended into

$$Y(1-p_L)^{-u}(1-p_G)^{-k} = YD(\bar{p}) \tag{12.2}$$

$$Y(1-p_L)^{-u}\ {p_G}^{-k} = YC \quad . \tag{12.3}$$

Moving the spillover term in (12.2) to the right-hand side, one may define aggregate goods supply as

$$YS = YC(1-p_L)^u \quad . \tag{12.4}$$

YS is aggregate goods supply in the sense of the maximum output level firms may supply, given that a proportion p_L of them is unable to operate technical capacities YC fully due to a labor supply constraint.

Note that division of (12.2) by (12.3) still gives (7.4). This is in accordance with the assumption that the capacity assessment of firms is based on a comparison of goods demand and technical capacities and not affected by potential labor supply constraints. Put differently, firms with $YS_i < YC_i < YD_i$ are assumed to report capacities as being too small. This introduces a certain *recursivity* into the model with respect to the determination of p_G and p_L. First, by comparing aggregate goods demand with technical capacities in (7.4), one obtains p_G. Then, given p_G, one confronts effective labor demand with labor supply in (9.4), which determines p_L. Finally, the larger p_L is, the more falls Y short of YC and YD in (12.2) and (12.3).

Next, we turn to the impact of excess demand on *price formation*. Starting point is equation (12.3), which says that only in a limiting situation where $p_G \to 0$ and $p_L \to 0$ does aggregate output Y converge to aggregate demand at $\bar{p}$. Or conversely expressed, if a certain proportion of firms is constrained by technical capacities and/or labor supply, aggregate demand at $\bar{p}$ will

exceed aggregate output, and this induces the constrained firms to raise the price. A straightforward measure for excess demand in the aggregate price equation thus is

$$YD(\bar{p})/Y = (1-p_G)^{-k}(1-p_L)^{-u} \quad ,$$

and, reintroducing the time-subscript, we may write

$$p_t = \bar{p}_t \left(\frac{YD(\bar{p})_t}{Y_t} \right)^t \tag{13.1}$$

or, substituting from (6.1) and (6.2):

$$p_t = \left(\frac{h}{h-1} \right) w_t^{\,a}\, v_t^{\,1-a}\, e^{-qa\,t} \left(\frac{YD(\bar{p})_t}{Y_t} \right)^t \tag{13.2}$$

In the empirical model, (13.2) is applied to the *GDP-deflator*.

The *nominal wage* is made dependent on a weighted average of the GDP-deflator and consumer prices, labor productivity and the demand/supply ratio in the labor market:

$$w_t = p_t^{k_1}\, pc_t^{(1-k_1)} \left(\frac{Y_t}{L_t} \right)^{k_2} \left(\frac{p_{L_t}}{1-p_{L_t}} \right)^{u\,k_3} \quad . \tag{14}$$

For estimation, (13.2) and (14) are brought into a logarithmic error correction form.

According to these specifications, there is a certain asymmetry between the impact of market tension on prices and wages. The price equation is based on the notion that firms confronted with excess demand at $\bar{p}$ raise the price above $\bar{p}$ while the remaining firms leave the price at $\bar{p}$. In case of the wage equation, however, the tension term may be rewritten on basis of (9.2), (9.3) and (9.4) as

$$\frac{(1-p_L)^{-u}}{p_L{}^{-u}} = \frac{LD/L}{LS/L} = LD/LS \quad .$$

Hence, both excess demand and excess supply matter for wage formation.

This specification of wage-price dynamics is in the spirit of Layard, Nickel and Jackman (1991). Equation (14) says that wages increase in relation to prices if the labor market gets tight (high p_L). Equation (13.2) says that firms raise prices in relation to wages if the goods market gets tight (high p_G). Hence, if both the goods and the labor market are tight, the formation of wages and prices becomes incompatible in the sense that the income claims of workers and firms add up to more than what is actually available for distribution. The result is accelerating inflation that must go to the point where real activity is dampened enough to make income claims compatible (by lowering p_L and p_G).

Finally, we have to specify *investment behavior*. As already noted above, this can be done in a straightforward manner on basis of the capacity output equation (2.1). By investing in new equipment, firms tend to bring actual capacity into line with *desired* capacity YC_t^*. Denoting the latter by YC_t^* one may solve (2.1) for the *desired investment rate*:

$$IR_t^* \equiv I_t^* \big/ YC_{t-1} = \left(\frac{YC_t^*}{YC_{t-1}} - S_t \right) \big/ B_t \qquad (16)$$

For a certain desired expansion rate of technical capacities (YC_t^*/YC_{t-1}), required investment depends on the amount of scrapping of existing equipment (reflected in S_t) and capital productivity on new equipment (B_t). To allow for adjustment cost and other factors that may cause inertia in the investment process, (16) is augmented in the empirical application by a simple partial adjustment scheme.

In order to make specification (16) workable, we have to define desired capacity YC_t^*. Since $\bar{p}$ is the optimal long-run markup price, one might simply equate YC_t^* to demand at this price, i.e. $YC_t^* = YD(\bar{p})_t$, as suggested by Figure 1. However, in a model where production activity of firms may temporarily be hindered by labor shortages, the question arises whether this might have a negative impact on desired capacities and thus investment. Business surveys questions about potential impediments to investment suggest that labor shortages may play an important role.[9] Hence, desired capacity YC_t^* should be defined in a way that allows for potential labor supply constraints. A heuristic way to do so is as follows. Going back to the firm level, we may express (12.1) equivalently as

$$Y_i = \min\left(YC_i, YDS_i\right) \quad \text{where} \quad YDS_i = \min\left(YD(\bar{p})_i, YS_i\right) \qquad (17.1)$$

YDS_i is the firm's maximum production level if only product demand and a potential labor supply constraint are taken into account. It seems reasonable then to assume that investment at the firm level depends on a comparison between YDS_i and YC_i. At the aggregate level, one may write in analogy to (7.2) and (7.3):

$$Y(1-p_{G^*})^{-k} = YDS \qquad (17.2)$$

$$Y p_{G^*}{}^{-k} = YC \ . \qquad (17.3)$$

p_{G^*} is still the proportion of firms constrained by capacities, but in a *modified sense*, namely that YDS_i (and not $YD(\bar{p})_i$) exceeds YC_i. By comparing (12.3) with (17.3), one easily sees that p_{G^*} is implicitly defined as

$$p_{G^*} = (1-p_L)^{u/k} p_G \ .$$

Hence, (17.2) can be restated as

$$Y\left(1-(1-p_L)^{u/k} p_G\right)^{-k} = YDS \ . \qquad (17.2')$$

---

[9] Such a question is regularly asked in a survey conducted by KOF (Centre for the Research of Economic Activity, ETH Zurich). In this survey, the percentage of firms in manufacturing reporting labor shortages as an impediment to investment was 27% in 2000 and 38% in 2001, for instance. For services, the corresponding numbers are 21% and 27% and for construction 38% and 58%.

This definition of *YDS* is substituted for desired capacity into (16), i.e.:

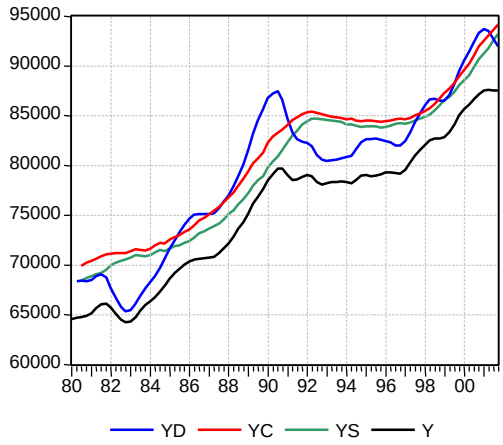
$$YC_t^* = YDS_t \quad . \tag{18}$$

These considerations become particularly relevant in the simulation of the bilateral agreements. The possibility for Swiss firms to circumvent domestic labor shortages by recruiting qualified personnel in the EU will have a positive impact not only on output but also on investment. Technically, relaxing the labor supply constraint lowers p_L and thus moves YDS_t closer to $YD(\bar{p})_t$, entailing in (16) an increase of desired capacity YC_t^*.

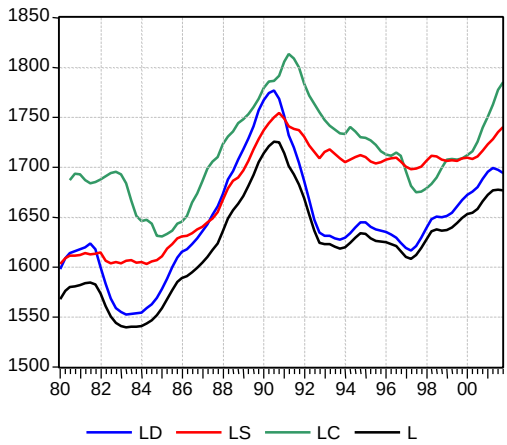
It is beyond the scope of this paper to go into any details about estimation results. In the following two sections, we will just provide a brief discussion of those parameter estimates that are central to the issues investigated, namely the cyclical flexibility of labor supply and the free movement of labor between the EU and Switzerland.

Figure 3: Changing tension situations on Switzerland's goods and labor market

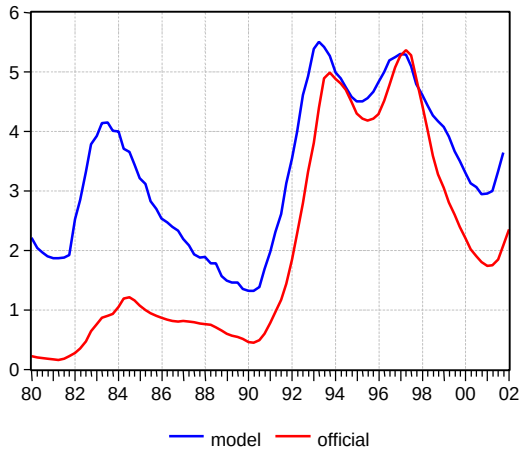
a) Goods market



b) Labor market



c) Model-implied and official unemployment rate



Before we turn to these issues, it is instructive to have a quick look at the *changing tension situations* on Switzerland's goods and labor market. Once the empirical parameters of the model are estimated, we can compute several interesting but not directly observable variables. According to these calculations, shown in *Figure 3*, Switzerland's goods market was predominantly demand-constrained in the period 1982-84 and again in 1991-96 ($YD < YC, YS$). Supply constraints became binding in the second half of the 1980's and again after 1998 ($YD > YC, YS$). In 1980-81 and in the second half of the 1980's, production was moreover to some extent impeded by labor constraints ($YS < YC$). In general, however, Switzerland's labor market was also mostly demand-constrained. Exceptions are the periods 1980-81 and 1987-90, where $LD > LS$. From 1996 onwards, the labor market got successively tighter, with LD approaching LS, but never as tight as in the period 1989-90. The fact that employment L and output Y always lie to some extent below the minimum of aggregate demand and supply reflects structural mismatch between demand and supply. The mismatch shows up most strongly in situations where aggregate demand and supply intersect (for example in 1980). The model furthermore suggests that official Swiss unemployment statistics (not used in the estimation of the model) have underestimated the true amount of unemployment to a significant degree in the 1980's.

3 Cylical flexibility of labor supply

Cyclical flexibility of labor supply in the sense of a retreat from the labor market in response to unfavorable employment prospects is captured in the model by parameter W ; see equations (11.1) and (11.2) above. A large value of W implies a high cyclical flexibility of labor supply. Using the full available sample, which starts in 1981Q1 and ends in 2001Q4, we obtain for W an estimate of 0.541 with a standard error of 0.101. As can be seen from *Table 1*, the estimate for W assumes a somewhat larger value for the period 1981-1990 but a much smaller value for the period 1991-2001. These estimates are subject to relatively small standard errors. Accordingly, a Chow test based on the sums of squared residuals reported in the bottom line of the table strongly rejects the hypothesis of a stable W with a p-value = 0.00024. We thus conclude that the cyclical flexibility of labor supply has substantially declined over time. The consequences of this change will be discussed in the framework of the complete model below.

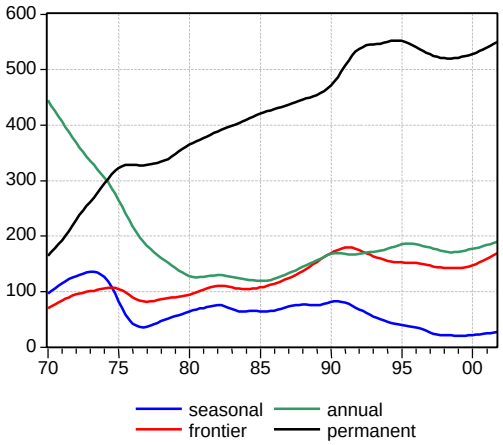
Table 1: Cyclical flexibility of labor supply

Estimates of parameter W for different sample periods

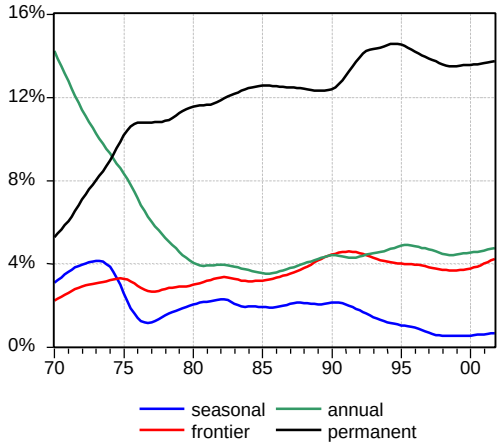
	1981q1-2001q4	*1981q1-1990q4*	*1991q4-2001q4*
Estimate	0.541	0.656	0.183
Standard error of estimate	0.101	0.111	0.131
Standard error of equation	0.00287	0.00242	0.00282
Sum of squared residuals	0.000651	0.000217	0.000326

Figure 4: Composition of foreign employment by type of permission and cyclical buffer role

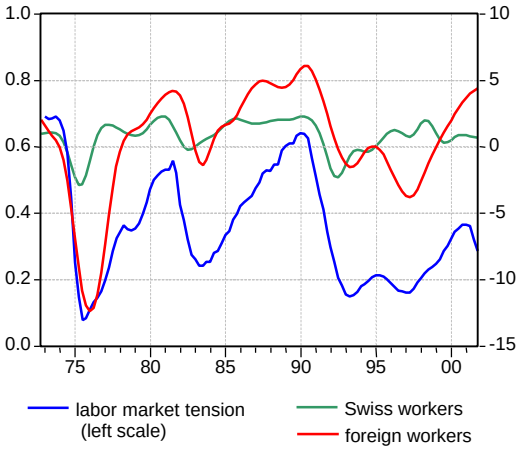
a) Employed foreigners by type of permission
in 1000, seasonally adjusted quarterly series



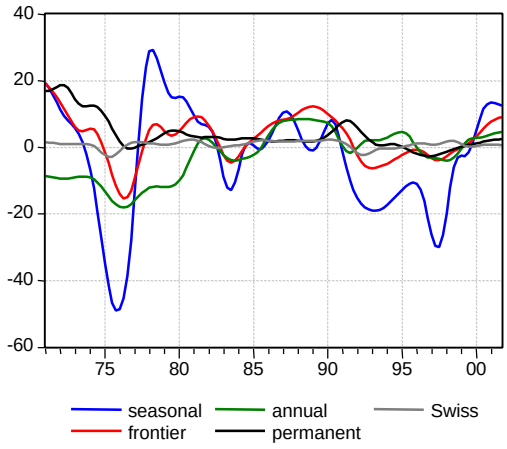
b) Employed foreigners by type of permission
as percentage of total employment



c) Labor market tension (proportion of firms reporting labor shortages) and employment of Swiss and foreign workes (percentage change)



d) Foreign employment by type of permission and Swiss employment (percentage change)



The introduction to this paper offered two explanations for a reduced cyclical flexibility of labor supply, namely (i) a changed composition of the foreign work force and (ii) a more permanent integration of women in the labor market. Obviously, the model is not detailed enough to differentiate between these two explanations (which are, of course, not mutually exclusive). On basis of other evidence, however, reason (ii) seems to be at least as important as reason (i) for explaining the reduction in cyclical flexibility from the 1980's to the 1990's. In particular, the main change in the composition of foreign employment took place before 1980. As shown in *Figure 4*, the number of foreign workers with *annual permits* (to be renewed every year) declined strongly during the 1970's, while the number of workers with *permanent residence permits* increased by about the same amount. Furthermore, while *frontier workers* (commuters who return to their home country daily) became more important over time, the

category of *seasonal workers* (returning to their home countries every year for at least three months) became almost negligible towards the end of the 1990's. Nevertheless, as can be seen from panels c and d in figure 4, despite the increased share of foreigners with permanent residence status, foreign employment continued to behave more cyclically than Swiss employment even in the 1990's and thus played a certain buffer role.[10]

In what follows, we want to analyze the macroeconomic consequences of the reduced cyclical flexibility of labor supply in the framework of the complete model. As mentioned at the beginning of section 2, for the purpose of this study the rather detailed representation of aggregate demand in the macromodel is replaced by a stylized aggregate demand curve. Its position is exogenously determined by nominal GDP (Y^n) so that "demand for real GDP" is simply given by $Y = Y^n p^{-1}$ with a price elasticity of minus unity. In this setting, a *negative demand shock* can be imposed by letting nominal GDP decrease in relation to a baseline simulation. Nominal GDP is lowered by 5% within eight quarters. Thereafter, nominal GDP permanently remains 5% below the baseline path.[11] In response to this exogenous change, the model shows the dynamic adjustments of real GDP, employment, unemployment, prices and wages. In a first simulation (S1), we set W = 0.656 (estimate obtained for the period 1981q1-1990q4), representing high flexibility of labor supply. In a second simulation (S2), we set W = 0.183 (estimate obtained for the period 1991q1-2001q4), representing weak flexibility of labor supply.

Figure 5 shows the simulation results in form of deviations from baseline paths over a time span of 48 quarters. The difference in the effect on the unemployment rate is surprisingly weak. In simulation S1 the peak increase is 2.2 percentage points, whereas it is 2.7 percentage points in S2 (panel b). The difference widens to 0.8 percentage points by the 13th quarter of the simulation. This is the maximum amount of additional unemployment due to the reduced cyclical flexibility of labor supply. The reason for the rather small difference lies in the fact that higher unemployment is partly *self-correcting* because it lowers wage and price inflation more strongly (panel c) and therefore entails a more speedy recovery of real GDP and employment. After an initial drop of about 4% in both S1 and S2, real GDP moves back towards the baseline path more quickly in simulation S2 (panel a). Six years after the negative demand shock, the output loss is still 1.6 percent in S1 but only 0.6 percent in S2. As can be seen by comparing panel d with panel e, the higher cyclical flexibility of labor supply also entails a much more persistent drop in employment. Six years after the demand shock, employment is still about 1.5 percent below baseline values, whereas in S2 the employment loss is reduced to 0.5 percent by this time.

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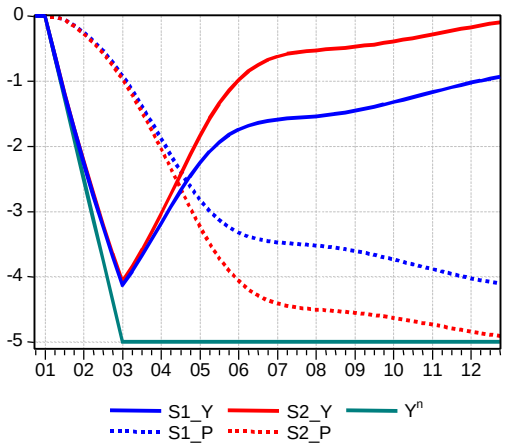
[10] The cyclical measure for labor market tension in panel c is p_L, the proportion of firms reporting labor shortages.

[11] On the assumption of a constant velocity, this could also be viewed as a 5% reduction of money supply.

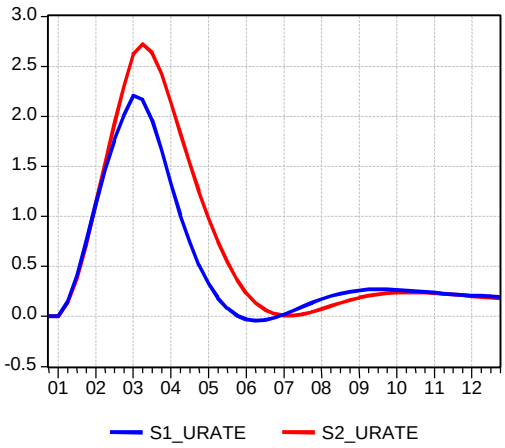
Figure 5: Negative demand shock and cyclical flexibility of labor supply

Simulation S1: high flexibility of labor supply
Simulation S2: low flexibility of labor supply

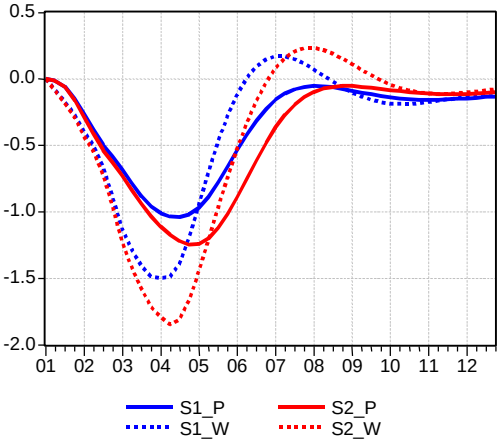
a) Output (GDP) and price (GDP deflator)
deviation from baseline levels in percent



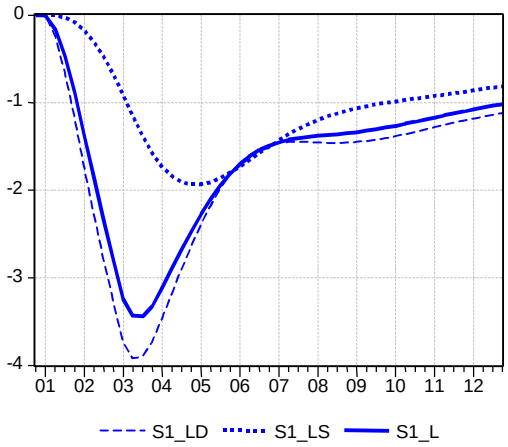
b) Unemployment rate
deviation from baseline levels in percentage points



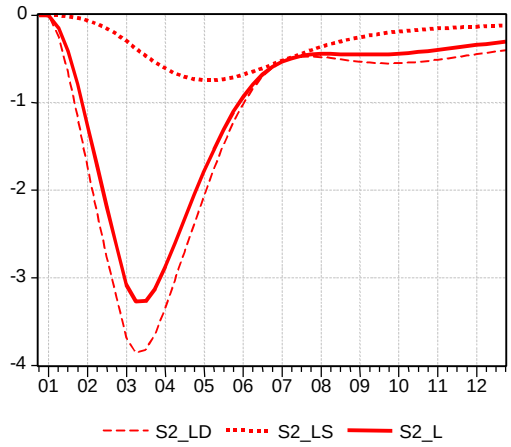
c) Wage and price inflation
deviation from baseline values in percentage points



d) Labor demand, labor supply, employment
deviation S1 from baseline levels in percent



e) Labor demand, labor supply, employment
deviation S2 from baseline levels in percentage

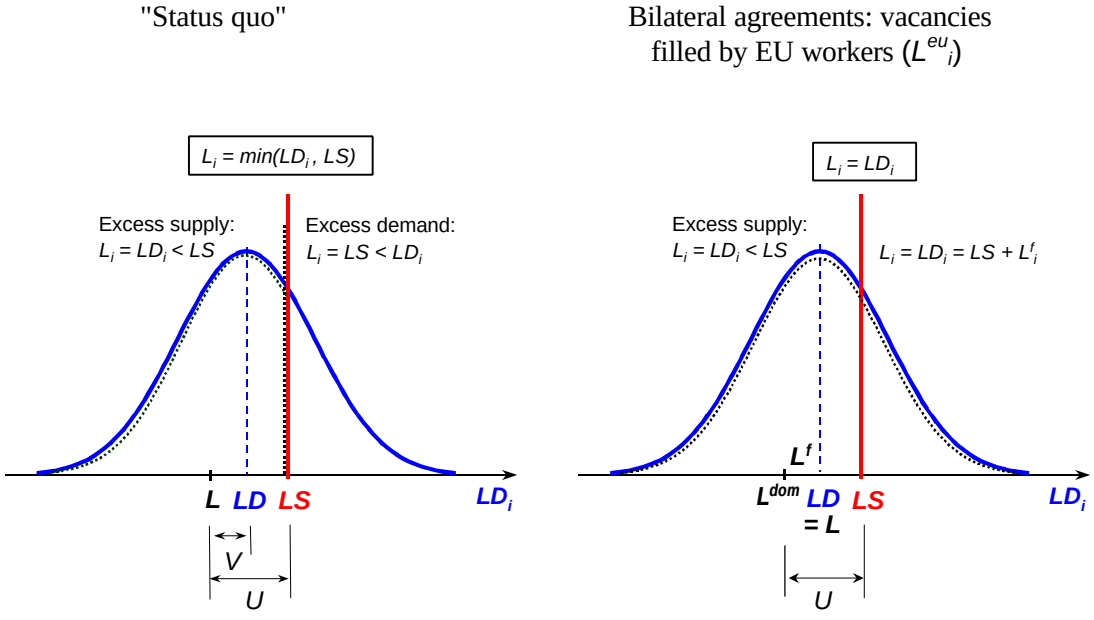


To summarize, one may say that the retreat of people from the labor market in response falling employment limits the incidence of unemployment to some extent. The flip side of the coin, however, is a notably more persistent drop in GDP and employment. Therefore, whether the higher cyclical flexibility of labor supply in earlier decades was actually economically advantageous for Switzerland, as sometimes claimed, seems rather questionable.

4 Free movement of labor between the EU and Switzerland

This section deals with the potential effects of the bilateral agreements with the EU on free movement of labor. In the following analysis, we adopt the official view that immigration from the EU will selectively fill those vacancies that would otherwise remain unfilled. This is illustrated in *Figure 6*. The left-hand diagram, which just reproduces Figure 2, refers to the "status quo". The dotted density function for the distribution of employment L_i across micro markets is *censored*. It corresponds to the density function for labor demand LD_i up to the *truncation* point *LS*. Firms with $LD_i > LS$ have unfilled vacancies. As a result, aggregate (or average) employment L falls short of both *LS* and *LD*. Under the bilateral agreements, firms with open vacancies may recruit workers from the EU. On the extreme assumption that all vacancies are filled, the situation would be as shown in the right-hand diagram of Figure 6, with a distribution of employment L_i that just corresponds to the distribution of labor demand LD_i. Aggregate (or average) employment L increases to the level of aggregate labor demand *LD*, and the formerly labor-constrained firms raise production. The number of additional EU-workers is $L^{eu}{}_i$ at the firm level and L^{eu} in the aggregate, corresponding to the difference between the increased new employment level L and the "domestic" employment level, which

Figure 6: "Status quo" and free movement of labor (bilateral agreements with the EU)



is relabeled in the figure as L^{dom}. The effect of the bilateral agreements thus is to eliminate vacancies, to raise aggregate employment and output but to leave unemployment unchanged, at least initially.

In the sequel, the dynamic adjustments in the economy are analyzed on basis the model. We assume that only a part of the vacancies existing under the "status quo" are filled with additional workers from the EU. More precisely, a random choice of 50% of the firms constrained by labor supply is assumed fill their vacancies with additional EU workers.

For this simulation, the model has to be slightly adapted. First, a distinction must be made between employment excluding and including the additional EU workers. In

$$L = L^{dom} + L^{eu} \tag{19}$$

L is total employment, L^{eu} is additional EU workers entering Switzerland under the bilateral agreements and L^{dom} is "domestic" employment, i.e. employment excluding those additional EU workers. The proportion of firms constrained by "domestic" labor supply is still denoted by p_L.

In order to determine L^{dom} and p_L, we may restate equations (9.2) and (9.3) as

$$L^{dom}(1-p_L)^{-u} = LD \tag{20.1}$$

$$L^{dom} p_L^{-u} = LS \tag{20.2}$$

The econometric specifications substituted for LD and LS remain unchanged. The unemployment rate is defined as

$$URATE = 1 - L^{dom}/LS = 1 - p_L^{u} \tag{21}$$

Next, the assumption is introduced that a share b of the firms constrained by domestic labor supply can fill their vacancies:

$$p_{L^*} = (1-b)p_L, \qquad 0 \le b \le 1 \tag{22}$$

p_{L^*} is the proportion of that are still labor-constrained firms after the hiring of the EU workers has taken place. The reduction in the proportion of labor-constrained firms from p_L to p_{L^*} is paralleled by an increase in employment from L^{dom} to L. So the counterpart to (20.1) in terms of p_{L^*} and L is

$$L(1-p_{L^*})^{-u} = LD \ . \tag{23}$$

The higher the value of b, the lower is p_{L^*} and the closer moves L to LD. According to (19), the excess of L over L^{dom} is covered by L^{eu}.

In some other equations of the model, p_L has to be replaced by p_{L^*}. These changes account for the fact that firms no longer constrained by labor supply will produce and invest more, which in turn reduces excess demand in the goods and labor market and thereby inflationary pressures. The equations in which p_L must be replaced by p_{L^*} are:

- Equations (12.2), (12.3) and (12.4): As a result, actual output Y moves closer to $YD(\bar{p})$ and YC. This automatically lowers the excess demand variable $YD(\bar{p})/Y$ in the price equation (13.2).
- Equation (17.2'): This entails larger desired capacities in (18) and thus higher investment in (16).
- Equation (14), but only in the denominator of the term capturing market tension:

$$w_t = p_t^{k_1} pc_t^{(1-k_1)} \left(\frac{Y_t}{L_t} \right)^{k_2} \left(\frac{p_{Lt}}{1-p_{L^*t}} \right)^{k3} \quad . \tag{24}$$

In order to understand this modification of the wage equation, notice that equation (9.4) of the original model can be rewritten on basis of (9.2) and (9.3) as

$$\frac{LD}{LS} = \frac{LD/L}{LS/L} = \frac{(1-p_L)^{-u}}{p_L{}^{-u}} \quad .$$

This makes clear that $(1-p_L)^{-u}$ is a measure for *LD/L* (excess demand) while $p_L{}^{-u}$ is a measure for *LS/L* (excess supply). In the adapted model, however, excess demand for labor according to (23) is reduced to

$$\frac{LD}{L} = (1-p_{L^*})^{-u} \ ,$$

while excess supply is still given by

$$\frac{LS}{L^{dom}} = p_L{}^{-u} \ .$$

The appropriate tension measure in the adapted wage equation (24) thus is

$$\frac{LD/L}{LS/L^{dom}} = \frac{(1-p_{L^*})^{-u}}{p_L{}^{-u}} = \left(\frac{p_L}{1-p_{L^*}} \right)^{u} \quad .$$

Obviously, these extensions include the original model as a special case, since if $b = 0$ we have $p_{L^*} = p_L$, $L = L^{dom}$ and $L^{eu} = 0$. In the other extreme, if we set $b = 1$ the model implies $p_{L^*} = 0$, $L = LD$ and $L^{eu} = LD - L^{dom}$, corresponding to the right-hand panel of figure 6.

In what follows, we compare the "status quo" ($b = 0$) with a scenario "bilateral agreements", for which we set $b = 0.5$. Hence, half of the vacancies in the "status quo" are filled with additional workers from the EU. Raising parameter b from 0 to 0.5 affects the steady state of the model. In addition, we also want to analyze the dynamic adjustments in the Swiss economy in the transition phase.

Due to the stylized representation of aggregate demand by the equation $Y = Y^n p^{-1}$, we just have *two exogenous variables* in the model, namely Y^n (nominal GDP or money supply in the background), which - graphically speaking - defines the position of the aggregate demand

curve, and *LF* (potential labor force) on the supply side of the labor market. The steady state growth path of the model can be determined numerically by letting these two exogenous variables grow over a sufficiently long time period with constant rates. Starting from an arbitrary historical situation, the model then converges to a steady state growth path with constant output growth and inflation, as shown in *Table 2.*

Table 2: Steady state growth path of the Model - effects of free movement of labor between the EU and Switzerland

		Status quo	Free movement of labor	
Exogenous assumptions				
		growth rate	*growth rate*	
Nominal GDP	Y^n	3.70%	3.70%	
Potential labor force	*LF*	0.80%	0.80%	
Endogenous variables				*change in level*
		growth rate	*growth rate*	*vs. status quo*
Employment	*L*	0.80%	0.80%	**4.90%**
Real GDP	*Y*	2.10%	2.10%	**5.60%**
Labor productivity	*Y/L*	1.30%	1.30%	**0.70%**
GDP-deflator	*p*	1.60%	1.60%	**-5.30%**
Consumer prices	*pc*	1.60%	1.60%	**-5.30%**
Nominal wages	*w*	2.90%	2.90%	**-3.80%**
Real wages	*w/pc*	1.30%	1.30%	**1.50%**
		level	*level*	
Unemployment rate	*URATE*	2.53%	**1.37%**	
official	$URATE_{off}$	1.96%	**1.06%**	
Vacancy rate	*VRATE*	1.63%	**1.12%**	
Investment rate	I/YC_{-1}	11.30%	11.30%	
Depreciation rate	*1-S*	10.00%	10.00%	

Setting the growth rate of the potential labor force *LF* to an annualized value of 0.8%, which is close to the average over the period 1980-2001, and given a technical progress parameter q of 0.00325 or 1.3% on an annual basis, the growth potential of the economy is 2.1%. If we set the growth rate of Y^n to an annualized value of 3.7%, which is somewhat lower than the average of the period 1980-2001, the overhang over the real growth potential absorbed by inflation is 1.6%. Nominal wage inflation is higher, namely 2.9%, implying real wage growth of 1.3%, which corresponds to the growth rate of labor productivity. The values of the regime proportions $p_{.G}$ and $p_{.L}$ to which the model converges are 0.48 and 0.42 respectively. The steady state value of $p_{.L}$, together with the estimate for the mismatch parameter u of 0.298, implies an equilibrium unemployment rate of 2.53%. This is the unemployment rate that keeps inflation constant (NAIRU). It is slightly higher than the so-called SURE (structural unemployment rate at equilibrium), which is the unemployment rate derived from the model for a hypothetical situation where *LD* = *LS* and thus $p_{.L}$ = 0.5. Applying formula (10.2), the estimate for SURE is 2.05%. In other words, in order to keep inflation constant, the labor

market must be in a state where *LD* is slightly lower than *LS*, implying that the NAIRU is somewhat higher than SURE as well as the equilibrium vacancy rate. The latter, defined as *VRATE* = 1 - *L/LD* , is estimated at 1.63%.

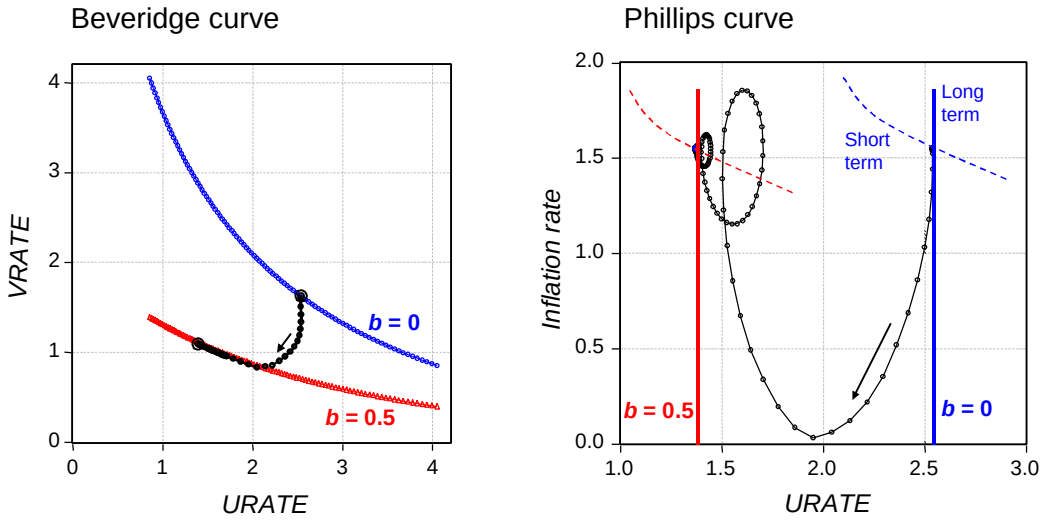
These measures for the NAIRU and the SURE are derived from the model, which was estimated without using the (historically unreliable) official unemployment statistics. As can be seen from Figure 3c, official unemployment rates were almost always lower than the model-implied unemployment rates. In the period 1991q1 to 2001q4, when the accordance between the two series became rather close, we have on average $URATE_{off} = 0.77 \cdot URATE$. Hence, by applying this factor of 0.77 to the above estimates, we get roughly a NAIRU of 1.95% and a SURE of 1.58% in terms of official unemployment statistics.

In the scenario "bilateral agreements", we raise *b* from 0 to 0.5. However, as an immediate filling of 50% of the existing vacancies by additional EU workers seems unrealistic, we spread the increase of *b* from 0 to 0.5 over 12 quarters. The resulting transition to the new steady state is shown in Figures 7 and 8.

Figure 7 shows the transition in terms of a Beveridge curve and a Phillips curve. The "status quo" ($b = 0$) is drawn in blue, the new equilibrium under the "bilateral agreements" ($b = 0.5$) in red and the transition between the two states in black. The steady state point on the original Beveridge curve, to which the model converges under the "status quo", is *URATE* = 2.5% and *VRATE* = 1.6%. On the original long-run Phillips curve, which is vertical at URATE = 2.5%, the equilibrium point is at an inflation rate of 1.6%. This particular inflation rate is not a "structural" phenomenon but simply due to the exogenous assumption of a growth rate of nominal demand exceeding the real growth potential of the economy by that amount.

Now, under the "bilateral agreements" labor-constrained firms may recruit workers in the EU. *Initially*, this leads to a nearly vertical downward movement in the *Beveridge diagram*. Open vacancies are filled, which allows formerly labor-constrained firms to rise production. As a result, excess demand in both markets is reduced. These are the initial effects. *Second-round* effects arise from reduced excess demand and the resulting moderating impact on inflation. Given an unchanged nominal expansion, lower inflation entails higher real growth. This effect is strong enough to induce an employment increase that goes beyond the number of additional EU workers. Domestic unemployment thus falls and - somewhat later in the simulation - the number of vacancies rises. In other words, the initial downward shift of the Beveridge curve (at a given level of unemployment it is easier for firms to fill their vacancies) is followed by a movement along the lower Beveridge curve towards higher economic activity (falling unemployment makes it somewhat more difficult for firms to fill their vacancies). The new equilibrium under the bilateral agreements is reached at *URATE* = 1.4% and *VRATE* = 1.1%.

Figure 7: "Status quo" and free movement of labor (bilateral agreements with the EU)
Shifts in the Beveridge and Phillips curve (status quo, bilateral agreements)



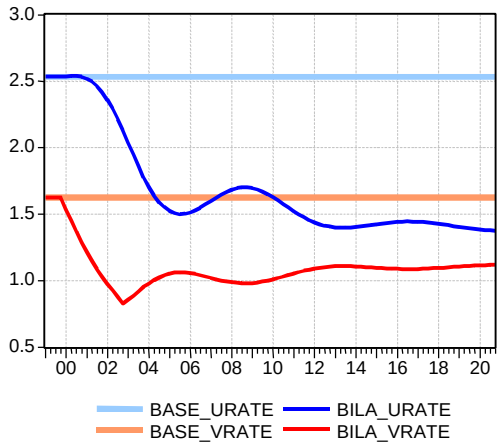
Corresponding to the downward shift of the Beveridge curve is a leftward shift of the *Phillips curve.* As a certain level of unemployment combines with less vacancies, there is less upward pressure on wages. The unemployment rate required to keep inflation stable (NAIRU) is therefore lower than in the "status quo". It falls from 2.5% to 1.4%. Given this shift in the Phillips curve, the initial unemployment rate of 2.5% lies in the area of falling inflation. Lower inflation then stimulates output and employment and thus reduces unemployment. Eventually, this process brings unemployment down to the lower NAIRU, as shown in Figure 7. In the new equilibrium, the inflation rate is the same as in the "status quo" because the overhang of nominal demand over the real growth potential is unchanged. In the transition phase, however, inflation is lower and real growth is higher. Once the higher level of activity is reached, GDP growth and inflation move back to the "status quo" values.

Figure 8 shows the transition to the new equilibrium over time. The time axis is not related to a concrete historical period since the baseline simulation is a hypothetical growth path. So the simulation just starts in a period 00q1, the quarter in which parameter *b* begins to increase. As soon as Swiss firms start hiring workers in the EU, the vacancy rate begins to decline. It quickly falls from 1.6% to 0.8% (panel a). The corresponding relaxation of the labor constraint allows firms to expand output. This *reduces excess demand* in the goods market in the sense of a positive supply shock. At the same time, however, it also *raises capacity utilization* as output moves closer to capacity output (technically defined). So, on the one hand, we have reduced excess demand in the goods market, which lowers inflation (panel b), leads to a fall in the price level relative to the "status quo" (panel c) and thus gives room for increasing GDP from the *demand side*. On the other hand, we have higher capacity utilization, which stimulates investment and thus brings the *supply side* of the economy into line with higher GDP (panel f). In the course of this expansionary process, the unemployment rate decreases from 2.5% to 1.4% while the vacancy rate, after an initial decline from 1.6% to 0.8%, moves slightly back to 1.1%.

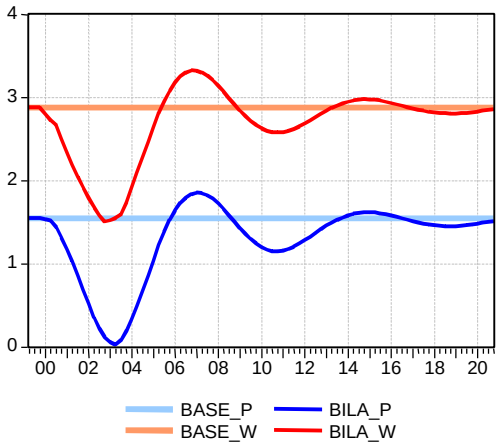
Figure 8: Effects of free movement of labor (bilateral agreements with the EU)

Simulation BASE: Status quo, Simulation BILA: Free movement of labor

a) Unemployment and vacancy rate

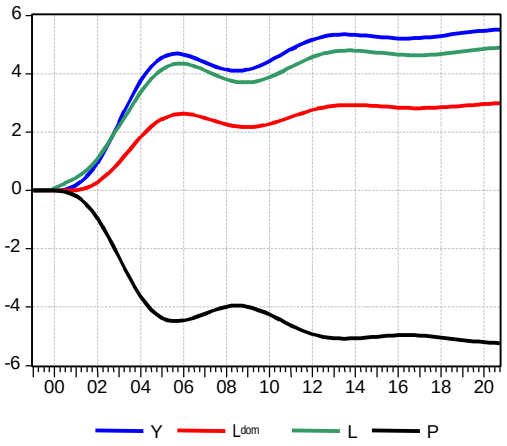


b) Price and wage inflation



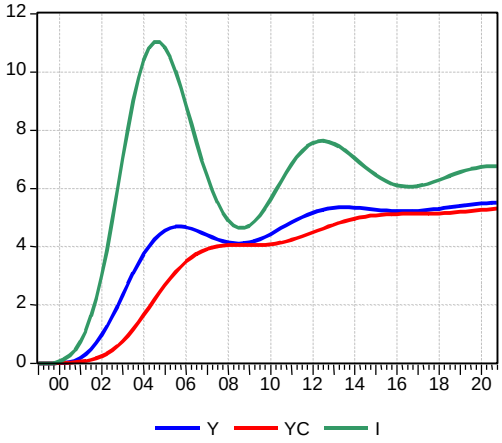
c) Real GDP, prices and employment

(BILA, deviations in percent from BASE)



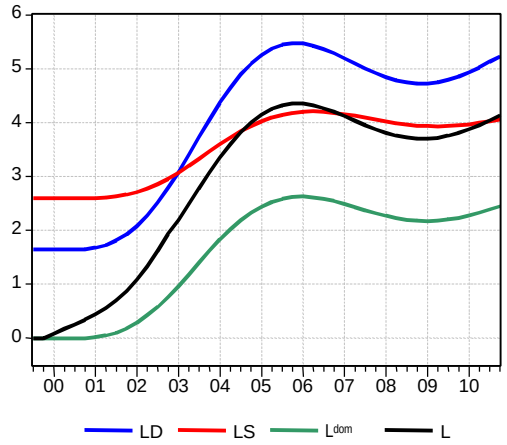
d) Real GDP, capacity output and investment

(BILA, deviations in percent from BASE)



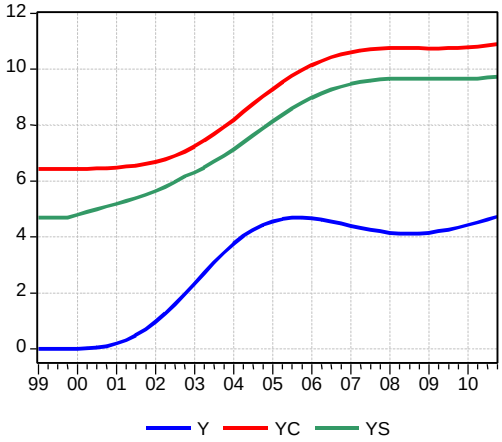
e) Labor demand, labor supply and employment

(BILA, deviations from BASE_L in percent)



f) GDP, capacity and labor-constrained output

(BILA, deviations from BASE_Y in percent)



With an increase of 5.5%, the long-term effect of free movement of labor on GDP is surprisingly strong (panel c). However, as employment shows an increase almost as large (4.9%), labor productivity is only weakly enhanced. Hence, the sizable GDP gain is mainly as a *scale effect*. The reason for the increase in labor productivity lies in the fact that new equipment is more productive than existing equipment. Therefore, a stronger expansion of capacity goes hand in hand with a certain increase in labor productivity.

The employment increase of 4.9% can be assigned on the supply side of the labor market to *three sources*, namely lower unemployment (1.1 percentage points), additional EU workers (1.9 percentage points) and higher domestic labor supply (1.8 percentage points). The latter contribution is due to the fact that labor market participation is positively affected by past employment. Put differently, favorable labor market conditions draw additional people into the labor force. This mechanism was discussed in more detail in section 3.

How should we assess the simulation results from a *policy perspective*? Most remarkable and at first sight rather surprising is the significant reduction in unemployment brought about by the opening of the Swiss labor market to EU immigrants. However, when interpreting this result, one should keep in mind that the assumptions underlying the simulation are neither based on a profound empirical investigation into the potential effects of free movement of labor nor on a model that is a priori open with respect to the outcome. In fact, the result is just a logical implication of the adoption of the official view that immigration from the EU goes exclusively in vacancies that would otherwise remain unfilled. The model lends itself quite naturally to capture this view because it explains the coexistence of vacancies (segments of the labor market in excess demand) and unemployment (segments of the labor market in excess supply) as a consequence of structural mismatch. Within this framework, filling vacancies with additional EU workers eliminates labor shortages, allows firms to raise production and thus necessarily improves the employment prospects in the other segments of the labor market. As another specific feature, the model uses as tension indicator in the wage equation not just unemployment, but - which seem reasonable - both unemployment and vacancies. Therefore, the reduction in vacancies reduces upward pressure on wages, so that lower unemployment is compatible with constant inflation.

5 Summary and Conclusion

Econometric forecasting models differ in many respects, both fundamentally and in detail. Despite these differences, they all have one thing in common: They assume that regularities in the co-movement of economic variables observed in the past can be carried over to the future. In fact, the assumption of *structural stability* is the cornerstone of forecasting quite generally, be it in economics or in other fields of research. To be sure, in some cases a careful empirical analysis may indicate that there are systematic changes in the joint behavior of the variables under consideration. In such situations, one would of course try to take these changes into

account when forming the forecast. But also in this case, the critical assumption is basically the same, namely that one may predict the future on basis of empirical regularities in the past. Unfortunately, however, even models that are based on a thorough empirical analysis often produce substantial prediction errors because this assumption does not hold.

Against this general background, this paper gives *two examples of structural change* that affect the behavior of the Swiss economy to a significant degree. The first one deals with the consequences of a reduced cyclical flexibility of labor supply, the second on with the potential impacts of the bilateral agreements with the European Union on free movement of labor, which became effective in June 2002. Both issues are analyzed within a macroeconometric model that is regularly used at Swiss National Bank in the monetary decision process.

Due to a rising proportion of foreign workers with permanent residence permits and a more permanent integration of women in the labor market, the *cyclical flexibility of labor supply* has decreased over time. It is shown in the paper that this empirical finding has consequences not only for the dynamics of unemployment but also with respect to wage and price formation and the persistence of changes in output and employment. In case of a negative demand shock, for instance, there is a larger increase in unemployment, hence a stronger reduction in wage and price inflation and therefore a quicker recovery of output and employment to the pre-shock levels. In other words, by making inflation more responsive to demand shocks the reduced cyclical flexibility of labor supply lowers the persistence of the cyclical movements in output and employment. This outcome is of course relevant with regard to the conduct of monetary policy.

In the second example, with the proviso that immigrants from the EU are only attracted into occupations characterized by a shortage of labor, it is shown that the *bilateral agreements on free movement of labor* have a mismatch-reducing effect on Switzerland's labor market and thus lower the threshold under which unemployment induces accelerating inflation. Again, neglecting this structural change in the model would give rise to wrong inflation forecasts and inappropriate monetary policy decisions. However, in contrast to the first issue, which can be investigated empirically, the analysis of free movement of labor remains rather speculative since it addresses the implications of an institutional change that are not yet observable.

In a related paper (Stalder, 2001a), two further changes in the economic structure relevant for monetary policy are analyzed. First, it is shown that a *higher rate of technical progress* reduces inflation quite strongly and therefore may make monetary tightening unnecessary in situations in which it would be required otherwise. Second, it is shown that *linking housing rents to the CPI instead of mortgage rates* enhances the efficiency of monetary policy so that a certain reduction in the inflation rate can be achieved with a less resolute tightening - and therefore a smaller depressing effect on GDP growth. While the first example is loosely related to a "New Economy" effect, the second one is motivated by an actual proposal to change Switzerland's legislation on tenancy protection, which presently allows house owners to pass higher mortgage rates in certain proportions to housing rents.

In view of these - and in fact many additional - examples of potential structural instabilities, one might be quite skeptical about the usefulness of econometric models as forecasting tools. However, unsatisfactory as the situation is, superior alternatives are difficult to find. Therefore, the conclusion of this paper is not that one should discard econometric models as forecasting tools but rather that one has to be very careful with respect to the assumption that regularities observed in the past will remain valid in the future. Sometimes systematic tests for parameter stability may indicate what has to be adapted in a model in order to preserve its forecasting performance, as was the case for the reduced cyclical flexibility of labor supply. In other cases, like the impact of the bilateral agreements, an empirical basis for such an analysis is lacking so that one has to rely on theoretical considerations and judgment.

REFERENCES

Bank of England, 1999, Economic Models at the Bank of England (Bank of England).

Benassy, J.P., 1986, Macroeconomics: An Introduction to the Non-Walrasian Approach (Academic Press).

Drèze, J.H. and Ch. Bean, 1990, Europe's Unemployment Problem (MIT Press, Cambridge).

Jordan, T. A. und M. Peytrignet, 2001, Die Inflationsprognose der Schweizerischen Nationalbank, Quartalsheft 2/2001 der Schweizerischen Nationalbank, p. 55-61.

Lambert, J.P., 1988, Disequilibrium Macro Models, Theory and Estimation of Rationing Models Using Business Survey Data (Cambridge University Press).

Layard, R., S. Nickel and R. Jackman, 1991, Unemployment (Oxford University Press, Oxford).

Lindbeck, A. and D.J. Snower, 1987, Union Activity, Persistence and Wage-Employment Ratchets, European Economic Review 31, p. 157-167.

Malinvaud, E., 1980, Profitability and Unemployment (Cambridge University Press).

Sneessens, H.R., 1990, Structural Problems in Macroeconomic Models, Structural Change and Economic Dynamics 1, p. 27-40.

Stalder, P., 1991, Regime Transitions, Spillovers and Buffer Stocks - Analysing the Swiss Economy by Means of a Disequilibrium Model (Lecture Notes in Economics and Mathematical Systems, Springer-Verlag, Berlin)

Stalder, P., 1994, Excess Demand, Capacity Adjustments and Price Setting - An Econometric Model for Swiss Manufacturing Based on Survey Data, KOF-Arbeitspapier Nr. 46 (Konjunkturforschungsstelle der ETH, Zürich).

Stalder, P., 2001a, Forecasting Swiss Inflation with a Structural Macromodel: The Role of Technical Progress and the 'Mortgage Rate - Housing Rent' Link, BIS Papers No. 3, Empirical Studies of Structural Changes and Inflation, Bank for International Settlements - Basel, p. 227-266.

Stalder, P., 2001b, Ein ökonometrisches Makromodell für die Schweiz, Quartalsheft 2/2001 der Schweizerischen Nationalbank, p. 62-89.