Capital Flows, Incomplete Markets, and the U.S.–European Unemployment Gap

Allen Head* Karlis Smits*

February 2004

preliminary and incomplete

Abstract

This paper investigates the relationship of the "unemployment gap" between the United States and Europe to the opening of international capital markets. The unemployment gap widened dramatically in the mid-1980's, a time period characterized also by significant increases in international capital flows–including substantial flows from Europe to the U.S.. The implications of capital mobility for unemployment levels and current accounts are studied in a multi-country dynamic model with incomplete international capital markets and national labor markets characterized by search and matching. The economy also features unemployment insurance financed by distorting taxes on capital and labour income. It is shown that a given difference in the generosity of unemployment benefits leads to a larger difference in unemployment rates across countries when there is some international capital mobility than in autarky. Moreover, the long-run effects of an opening of capital markets include an increase in the unemployment rate and an outflow of capital for high unemployment benefit countries and a reduction in the unemployment rate coupled with an inflow of capital for low benefit countries. In addition to these permanent effects, a opening of capital markets may have persistent transition effects including larger short-run differences in unemployment rates across countries and current account imbalances. Quantitatively, our model accounts for a significant share of the relative changes in both unemployment rates and international asset positions for the U.S. and several European countries since the mid-1980's.

*Department of Economics, Queen's University, Kingston, Ontario, Canada, K7L 3N6.

1. Introduction

During the first decades after the second world war unemployment rates in Western European countries were equal to or less than those in other developed economies, but in the 1970's the situation started to change and European countries experience significant increases in the unemployment rates relative to other industrial countries. Three important characteristics of *the European unemployment gap* are focus of extensive research. Firstly, unemployment rates in Europe have been persistently higher than ones in other OECD countries over the last two decades. Secondly, there is a clear pattern of divergence in unemployment rates across individual countries. Thirdly, there is an increase in duration of unemployment in countries of high unemployment rates.

In general, previous studies on unemployment gap can be divided in two main categories. Firstly, so called *shock-based theories* focus on how various economic turbulences effect labor markets. Clearly, the start of *the unemployment gap* coincides with significant changes in the global economy such as increased competition and globalization. Blanchard and Wolfens (1999) are more specific in identifying particular adverse events on labor markets in Europe. Among other things, total factor productivity decline experienced in Western Europe during the 1980's have had long lasting effects on employment. Productivity slowdown combined with higher real interest rates results in higher cost of capital that inducing lower capital accumulation and subsequently a decrease in employment.

Secondly, a significant proportion of studies focus on analyzing differences in institutional aspects of labor markets (also referred to as *labor demand side approach*). A range of researchers attribute strict regulations of European labor markets and other structural market rigidities as a source of *the unemployment gap*. Blanchard and Summers (1986) and Lindbeck and Snower (1988) have developed the *insider-outsider* theory that focuses on conflicts between employed and unemployed workers arising in highly unionized economies.

Ljungqvist and Sargent (1998) focus on dynamic responses of economic shocks to welfare states and find a close link between these two approaches and show that labor market rigidness can extend the transition path resulting from the external economic turbulences. Generous unemployment benefits combined with various restrictions on hiring and firing results in rigid economies vulnerable to big external shocks. They conclude that

the real explanation for persistently higher European unemployment levels is inability of high welfare economies to adjust to continuously changing economic environment.

Interestingly, the opening of the *unemployment gap* has coincided with significant movements of capital among industrialized countries. The increase of capital flows in the 1970's is attributed to technological evolution in the financial industry, petrodollar recycling, removal of many restrictions on capital movements, adoption of floating currency exchange rates. Although high unemployment rates in Europe coincide with significant capital outflows from the region, impact of capital flows on unemployment has been largely overlooked in literature.

Azariadis and Pissarides (2000) study the responses of domestic unemployment rates to a total factor productivity shock in countries with high capital mobility and low labor mobility. They show that capital mobility has important impact on the transition path adjusting from the total factor productivity shock. Countries with high capital mobility experience higher fluctuations in unemployment rates. This result is consistent with observation that variability of employment has increased in industrialized countries during the last decade. Several other studies have looked at a role of capital flows and have analyzed a relationship between employment and current account (two notable studies include Shi (1997) and van Wiljnbergen (1987)).

The purpose of this paper is to investigate a role of international capital movements on labor market in a multi-country dynamic general equilibrium model with incomplete international capital markets and national labor markets characterized by search and matching. The paper is structured as follows. Section 2 describes the unemployment and capital movement dynamics for the last decades in the United States and Western Europe. Section 3 describes the model. Section 4 analyzes the steady state effects and transitional dynamics of the economy. Discussion and concluding remarks are presented in section 5.

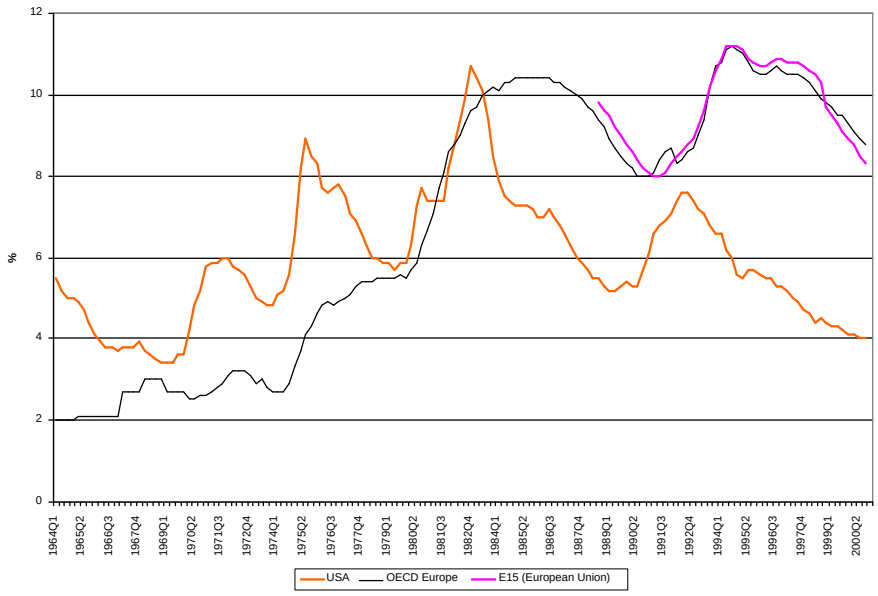
2. Evidence

2.1: Employment and Unemployment Dynamics

A robust post war economic expansion in Europe, Japan and North America during the 1950's and 1960's had kept unemployment rates at very moderate levels across the

OECD countries. In the 1970's the OECD economies experience two major oil price shocks (1973-1974 and 1979-1980) followed by significant changes in the economic environment in terms of increasing global competition and rapid technological advances. These events trigger a notable productivity downturn resulting in a large increase in the number of unemployed across industrialized countries, however, the rising trend in the unemployment is uneven across countries.

FIGURE 2.1. STANDARDIZED UNEMPLOYMENT RATE DYNAMICS



NOTE: SEASONALLY ADJUSTED QUARTERLY STANDARDIZED UNEMPLOYMENT RATES. STANDARDIZED UNEMPLOYMENT RATES FOR EUROPEAN UNION AVAILABLE FROM 1998.
SOURCE: QUARTERLY LABOUR FORCE STATISTICS, OECD

During the 1960's unemployment rates in the United States are slightly higher than the OECD average (including Western Europe), however, since the early 1970's there has been only a moderate trend increase in unemployment rates in the United States. In data we observe large fluctuations with peaks in mid 1970's, early 1980's, and early 1990's (see Figure 2.1). These fluctuations suggest that labor markets in the United States were quick to recover after exposures to the oil shocks and economic downturns.

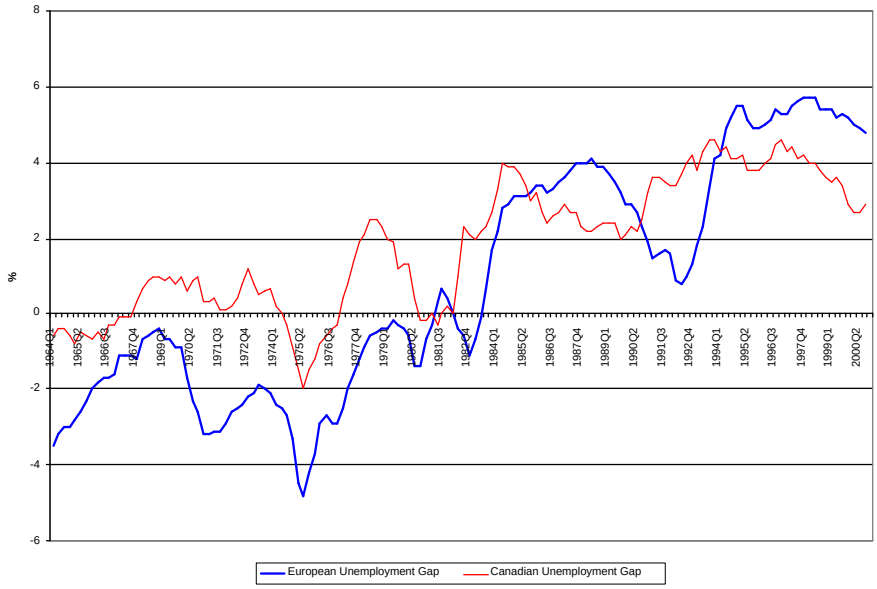
Fluctuations in European unemployment rates follow a similar pattern observed in the United States, however, average unemployment rates in Europe have risen sharply since mid 1970's (see Figure 2.1). In particular, the European unemployment rates are

more rigid in terms of adjusting to normal levels after economic downturns. This suggests a presence of so called *adjustment gap*, a slow adaptation to changing economic environment (OECD(1994)). As a result, since mid-1970's the unemployment rates in Europe are persistently higher than those in other developed countries, especially the United States (see Figure 2.2). Persistent nature of *the European unemployment gap* during 1980's and 1990's is a well documented empirical fact and focus of extensive research.

There exist significant differences in the shares of long-term unemployment among the OECD countries. In particular, European countries tend to have proportionally larger shares of long-term unemployment. While the long term unemployment shares had risen sharply in Europe during the recession of early 1980's with only a moderate decline during mid 1980's, in the United States there was only a moderate increase with prompt decline by mid-1980s[1]. The structure of the long-term unemployment suggests that inflow rates into the unemployment pool are lower (lower separation rates) in Europe comparing to ones in the United States. Once unemployed, workers in the United States have greater chances of returning to employment quickly. In addition, during the 1980's European countries lagged the United States in terms of employment growth. In Western Europe countries the employment increased only by 7% comparing to 19% in the United States for the same time period (OECD). Europe has suffered several concomitants of high unemployment, namely, reduced labor force participation and involuntary reductions in working hours.

[1] In 1983 proportion of workers unemployed for 1 year and over as percentage of unemployment accounted for 13.3 percent in the United States. By 1986 the share of long term unemployment declined to 8.7%. For comparison, in 1983 a share of long term unemployment accounted to 58.2% in Italy, 42.2% in France, 41.6% in Germany. Source: Labour Force Statistics 1980-2000, OECD

Figure 2.2 The European and Canadian Unemployment Gap with the United States



Note: Seasonally adjusted quarterly standardized unemployment rates.
Source: Quarterly Labor Force Statistics, OECD

Table 2.1 Net Unemployment Benefit Replacement Rates in 1994 for single-earner Households

	Single			With Dependent		
	1st Yr	2nd and 3rd Yrs	4th and 5th Yrs	1st Yr	2nd and 3rd Yrs	4th and 5th Yrs
Belgium	79	55	55	70	64	64
France	79	63	61	80	62	60
Germany	66	63	63	74	72	72
Netherlands	79	78	73	90	88	85
Spain	69	54	32	70	55	39
Sweden	81	76	75	81	100	101
United Kingdom	64	64	64	75	74	74
United States	34	9	9	38	14	14

Note: Benefit replacement rates are benefit entitlements on a net-of-tax and housing benefit basis as a percentage of net-of-tax earnings. Data for Sweden and the United Kingdom pertain to 1995.
Source: Martin (1996), table 2

Traditionally, differences in institutional framework of labor market policies are considered to be a leading cause for observed differences in the unemployment rates among the OECD countries, including *the European unemployment gap*. Various labor market protection mechanisms distort incentives of economic agents (workers, firms) resulting in inability to meet demands of changing economic environment.

Unemployment insurance based on earnings replacement rates is one of the most studied and used labor market policy tools. Although significant differences exist among individual countries, the unemployment benefit rates relative to average earnings (replacement rates) are generally higher in Europe than in other OECD countries, especially the United States (OECD (1994)). In addition, during the 1970's and 1980's several countries have increased their unemployment benefit rates (Blanchard and Wolfens (1999)). This increase is especially significant in several small European countries (Denmark, Norway, Finland, Portugal, Spain, Ireland, Sweden, and Switzerland). Some European countries such as Germany and the U.K. have resisted the rise, however, the rates remain higher than ones observed in the United States. Table 2.1 provides an example of average replacement rates for a typical 40 year old worker with previous job experience in the mid-1990's.

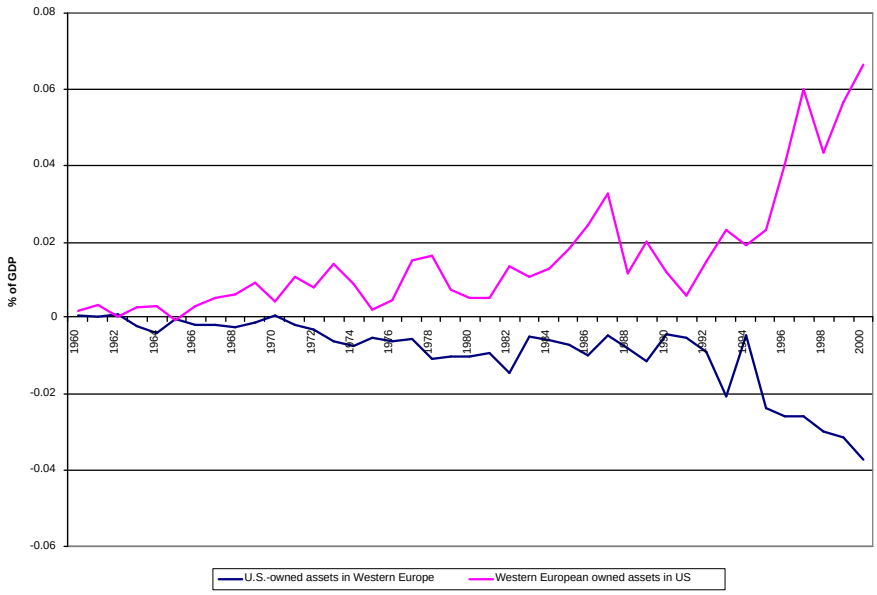
2.2: Capital flows

Although the first post war decades (1950's, 1960's) are marked by remarkable economic expansion in the OECD countries, the post war Bretton-Woods financial system is characterized by presence of various restrictions on international capital mobility. Initially, these controls were designed as a mechanism to prevent currency crises and runs in presence of a fixed exchange rate system. The collapse of the Bretton-Woods system and subsequent introduction of floating exchange rates in the 1970's allowed governments to ease various restrictions on capital movements. Liberalization of capital markets combined with the technological evolution in the financial industry, and petrodollar recycling resulted in significant increases in international capital movements that are reflected in their current account fluctuations. During the 1980's and 1990's globalization of business environment combined with closer economic integration of the OECD countries has fostered the importance of international capital movements. By late 1990's the world capital

movements have surpassed the levels observed before the first world war (Obstfeld and Taylor (2002)).

A steady increase in cross border capital movements in early 1980's coincides with reversing direction of the flows. Although most of the capital flows still occur among the developed nations, the United States from being a net lender becomes a net recipient of capital. Since early 1980's the United States began accumulating negative trade balance that resulted in sharp increase in the current account deficit (capital account surplus). With brief exceptions in early 1990's, the United States has persistently maintained negative current account balances for the last two decades with a sharp increase in late 1990's. The United States continues to maintain significant current account deficit both in nominal and real terms.

FIGURE 2.4 TOTAL ASSET INFLOWS/OUTFLOWS BETWEEN WESTERN EUROPE AND UNITED STATES AS A PERCENTAGE OF THE US GDP

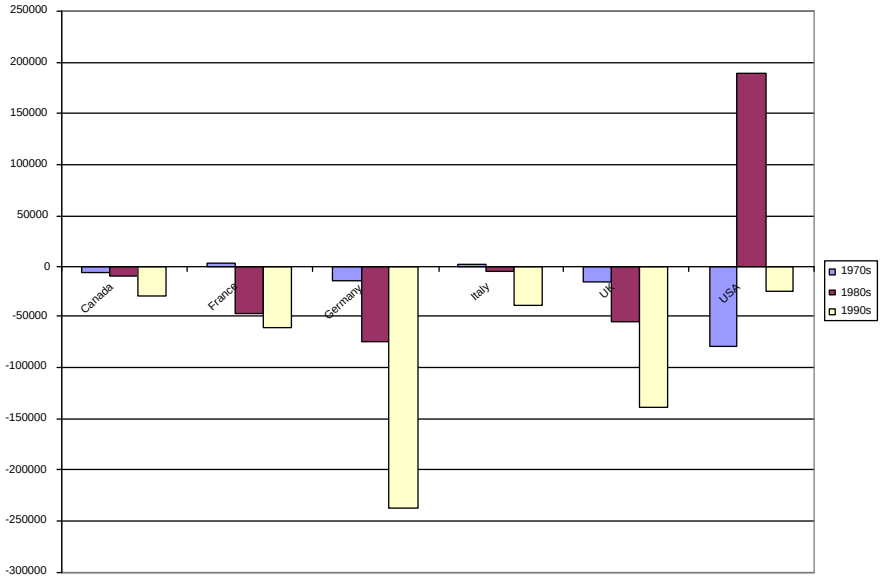


SOURCE: BUREAU OF ECONOMIC ACTIVITY

With respect to the flows of capital between the United States and Europe (inflow of European-owned assets in the United States and the U.S. owned assets in Europe) we see a steady increase in the flows during the last decades, with significant increases in the

second part of the 1990's (see Figure 2.4). This is not surprising, as the United States remained the prime destination to majority of capital outflows from Europe and Japan. Dynamics of the flows show slight volatility, especially in the beginning of 1990's (partly due to unification of Germany), however, it is clear that the United States is a net borrower of capital from Europe during the last two decades.

FIGURE 2.5 CUMULATED FDI STOCK IN SELECT OECD COUNTRIES (MLN USD)



SOURCE: INTERNATIONAL DIRECT INVESTMENT STATISTICS YEARBOOK, OECD FIGURE INCLUDES STATISTICS UP TO 1998

Furthermore, similar patter arises when data on flows of foreign direct investments (FDI) is analyzed. The United States has managed to accumulate a significant cumulative direct investment capital stock during the 1980's, while other major OECD countries experienced outflows (see Figure 2.5). FDI positions in the 1980's are different to ones in the 1970's, when direct investment flows were still relatively small and the United States shows a negative cumulated FDI stock. During the 1990's FDI flows in the OECD countries have increased significantly resulting in significant FDI outflows in the UK, and Germany.

The opening of *the European unemployment gap* coincides with significant changes in international capital flows, in particular, an increase in European unemployment rates

coincides with significant outflow of capital from the region. It is evident that these structural changes in unemployment and capital flow dynamics start in the 1970's as a result of significant external shocks and changes in economic environment. This suggests that the outflow of capital from Europe throughout 1980's and 1990's combined with various rigidities in labor market has contributed to the unemployment growth in the Western Europe.

3. The Economy

3.1: The Environment

The world is comprised of two symmetric countries of equal size. There is no uncertainty and time is discrete. Each country is populated by a large number of identical households, with each of these households comprised of a unit measure of members. In each period, measure n of these members is employed (*i.e.* supplying labor to a firm), measure s are searching for employment, and the remaining members (measure $1-n-s$) are idle. The allocation of members to particular activities is determined by household choices. All members care only about overall household utility; they do not have independent objectives and make no independent decisions.

There is a single consumption good available in each period. A household derives utility from consumption of this good and from leisure, where the quantity of leisure consumed in a given period is proportional to the measure of household members that are idle in that period. Households have preferences that order infinite horizon consumption-leisure plans. Let ψ_{jt} denote the time t value of the utility to a country j, $j = 1, 2$, household from a given consumption-leisure plan that runs from time t on. We assume that ψ_{jt} can be written recursively as,

$$\psi_{jt} = u(c_{jt}, \ell_{jt}) + \beta(c_{jt}, \ell_{jt})\psi_{jt+1} \qquad j = 1, 2 \quad \forall t, \tag{3.1}$$

where $\ell_{jt} \equiv 1 - n_{jt} - s_{jt}$, $u(\cdot)$ denotes the household's period utility, and the function $\beta(\cdot)$ governs the rate at which the household discounts future utility.

Let $u(\cdot)$ be strictly increasing in both arguments and strictly concave. Specifications for the discount factor function $\beta(\cdot)$: decreasing and strictly concave, thus exhibiting

increasing marginal impatience. We restrict attention to specifications in which preferences exhibit weak separability in the sense of Shi (1994), which requires

$$\frac{\beta_c}{u_c} = \frac{\beta_\ell}{u_\ell}. \tag{3.2}$$

Weak separability in this sense may be interpreted as the requirement that the marginal rate of substitution between consumption and leisure depend on the levels of c and ℓ in the future, but not in the past.

In each country the single consumption good is produced by means of a constant returns to scale technology. This good is produced by a competitive industry consisting of a large number of identical firms. Let y_{jt} denote the output of a representative country j firm[1] in period t, where

$$y_{jt} = F(k_{jt}, n_{jt}) \qquad j = 1, 2. \tag{3.3}$$

Here k_{jt} and n_{jt} denote the capital and labor employed by this firm. The production function $F(\cdot)$ is strictly increasing and concave in both arguments with $\lim_{k_j \to 0} F_k = \infty$ and $\lim_{n_j \to 0} F_n = \infty$.

Physical capital is produced by each household in each country using a standard intertemporal technology. The law of motion for a country j household's capital stock is

$$k_{jt+1} = (1 - \delta)k_{jt} + i_{jt} \qquad \delta \in (0, 1) \qquad j = 1, 2. \tag{3.4}$$

Here δ denotes the one-period depreciation rate for capital and i_{jt} is household investment in country j at time t in units of time t consumption good.

Country j households are endowed with one unit of time per period, equal shares of ownership in the initial aggregate country j capital stock, K_{i0}; and equal shares in all country j firms.

Markets for goods and capital are competitive. The labor market, however, is not Walrasian but rather is characterized by search and random matching of workers with firms. Wages are determined by bargaining once a match is made. Let N_{jt} denote the

[1] Throughout, lower case letters will be used to denote per capita or per firm quantities, and upper case letters to denote aggregates.

aggregate measure of country j household members that are matched with firms in period t. Then the number of workers matched with a firm at time $t+1$ will depend on the share of the previously matched workers who remain with their firms and the number of new matches that are formed during period t. These new matches will be determined by the number of vacancies posted by country j firms at time t, V_{jt}, and the measure of country j household members who search for employment in period t, S_{jt}, according to the matching function,

$$M_{jt} = M(V_{jt}, S_{jt}) \qquad j = 1, 2. \tag{3.5}$$

$M(\cdot)$ exhibits constant returns to scale and is strictly increasing and concave in both arguments with $\lim_{V_j \to 0} M_1 = \infty$ and $\lim_{S_j \to 0} M_2 = \infty$ $j = 1, 2$. We may then introduce notation for the average rates at which unemployed (*i.e.* searching) workers and unfilled vacancies are matched, respectively:

$$m(V, S) = \frac{M}{S} = X^{\alpha} \qquad\qquad \mu(V, S) = \frac{M}{V} = X^{\alpha - 1}, \tag{3.6}$$

where $X \equiv V/S$ will be referred to as *labor market tightness*. The aggregate number of active matches (*i.e.* employment) in country j then evolves over time according to

$$N_{jt+1} = (1 - \theta) N_{jt} + M(V_{jt}, S_{jt}) \qquad j = 1, 2. \tag{3.7}$$

In each country there is a government which consumes, collects lump-sum taxes, and pays subsidies to households in proportion to the measure of household members who are searching for employment. The government has no explicit objective, but must satisfy the following budget constraint,

$$-T_{jt} + G_{jt} + \tau_j w_{jt} S_{jt} = 0, \qquad j = 1, 2, \quad \forall t. \tag{3.8}$$

In period t, T_{jt} is the lump-sum tax, G_{jt} is government consumption, and $\tau_j \in (0, 1)$ determines the subsidy paid to searching workers as a fraction of the current wage.

The aggregate state of the economy may then be summarized by

$$\Gamma_t = \big(K_{1t}, K_{2t}, N_{1t}, N_{2t}, G_{1t}, G_{2t}, B_{1t}\big), \tag{3.9}$$

where B_{1t} denotes claims held by households in country 1 to units of the time t consumption - investment good owned by country 2 households. With regard to these claims, we restrict attention to two different regimes for international capital markets. In the first regime international borrowing and lending are prohibited. Because there is only one consumption - investment good and labor is assumed to be internationally immobile, this is sufficient to force the two countries into autarky. In this case, $B_{1t} = 0$ for all t. In the second regime international borrowing and lending is limited to trade in one-period non-contingent bonds, of which the net supply is zero. The capital account balance in country i evolves as follows:

$$CA_{it} = -\big(B_{it+1} - B_{it}(1 + R_t)\big)$$

3.2: Optimization

Consider first optimization by firms. Since firms in the two countries are entirely symmetric, the subscript j will be suppressed. Also, to simplify exposition, the subscript " $_t$ " will be dropped from current period variables and a superscript " $'$ " will be used to denote the value of a variable in the next period. A representative firm chooses a quantity of capital to rent, k_f, and a number of vacancies, v to post as functions of its individual state in each period in order to maximize the present value of its dividends. Let $H(n_f, \Gamma)$ denote the value of a firm with n_f workers in the current period when the current aggregate state is Γ. Given (3.6), the law of motion for the individual firm's matches with workers is given by

$$n'_f = (1 - \theta)n_f + \mu(V, S)v, \tag{3.10}$$

Let π denote the firm's current profits. Then,

$$\pi(n_f, \Gamma) = F(k_f, n_f) - r(\Gamma)k_f - w(\Gamma)n_f - pv, \tag{3.11}$$

where $r(\Gamma)$ and $w(\Gamma)$ denote the rental rate of capital and wage as functions of Γ, respectively and p is the marginal cost of posting an additional vacancy. We then have

$$H\big(n_f, \Gamma\big) = \max_{k_f, v}\left\{\pi(\Gamma) + \frac{1}{1 + R(\Gamma')}H\big((1 - \theta)n_f + \mu(\Gamma)v, \Gamma'\big)\right\}, \tag{3.12}$$

where $R(\Gamma)$ and $\mu(\Gamma)$ are the interest rate and matching rate for vacancies as functions of the aggregate state, Γ. The first-order conditions satisfied by the optimal choices for k_f and v give rise to

$$F_k = r(\Gamma) \tag{3.13}$$

$$p = \frac{\mu(\Gamma)}{1 + r(\Gamma')}\left[F'_n - w(\Gamma') + \frac{p(1-\theta)}{\mu(\Gamma')}\right]. \tag{3.14}$$

We now turn to optimization on the part of households. The state of a household is determined the number of its members who are currently matched with firms, n, and its holdings of physical capital, k, and foreign bonds, b, in addition to Γ. Given (3.6), the measure of household members matched with firms evolves according to

$$n' = (1-\theta)n + m(V,S)s, \tag{3.15}$$

Using the law of motion for household capital, (3.4), the household's budget can be written,

$$c + k' + b' = [r(\Gamma) + 1 - \delta]k + w(\Gamma)n + \tau w(\Gamma)s + \pi(\Gamma) + [1 + R(\Gamma)]b - T. \tag{3.16}$$

Let $J(k, b, n, \Gamma)$ denote the value of future utility to a household in state (k, b, n, Γ). Then,

$$J(k,b,n,\Gamma) = \max_{s,k',b'}\left\{u(c, 1-n-s) + \beta(c, 1-n-s)J(k', b', n', \Gamma')\right\} \tag{3.17}$$

subject to (3.15) and (3.16). Defining

$$\Psi(c, \ell, k', b', n', \Gamma') = u(c, \ell) + \beta(c, \ell)\psi(k', b', n', \Gamma'), \tag{3.18}$$

the first-order conditions for optimal choices of k', b', and s then imply

$$\frac{\Psi_c}{\Psi'_c} = \beta(c, \ell)[1 + R'] \tag{3.19}$$

$$\frac{1}{\beta(c,\ell)m}[\Psi_\ell - w\tau\Psi_c] = \frac{1-\theta}{m'}[\Psi'_\ell - \tau w'\Psi'_c] - [\Psi'_\ell - w'\Psi'_c]. \tag{3.20}$$

Note that if $\beta(c,\ell)$ is a constant, $\bar{\beta}$, then utility is time-separable with $\Psi_c = u_c$ and $\Psi_\ell = u_\ell$.

3.4: Wage Determination

Wages are determined by Nash bargaining between a matched worker and firm. In such a match, the surplus accruing to the worker's household can be written $w\Psi_c - \Psi_\ell$. The surplus accruing to the firm can be written $F_n - w$. We assume that the wage solves the following maximization problem,

$$\max_w [w\Psi_c - \Psi_\ell]^\lambda [F_n - w]^{1-\lambda}, \tag{3.21}$$

where $\lambda \in [0,1]$ determines the relative bargaining power of the workers in the negotiation. Solving (3.21) we obtain:

$$w = \lambda F_n + (1-\lambda)\frac{\Psi_\ell}{\Psi_c}. \tag{3.22}$$

As is standard in matching models, the wage is a weighted average of the marginal value product of labor, F_n, and the household's *reservation wage*, Ψ_ℓ/Ψ_c.

3.5: A Recursive Equilibrium

We assume that the time paths of the government expenditures, $\{G_{jt}\}_{t=0}^{\infty}$, and the subsidy rates, τ_j, $j = 1,2$ are exogenously given. For an economy with these characteristics, a recursive equilibrium is a collection (for each country) of policy functions, $k'(k,b,n,\Gamma)$, $s(k,b,n,\Gamma)$, $b'(k,b,n,\Gamma)$, $v(n,\Gamma)$, and $k_f(n,\Gamma)$; value functions for households and firms, $J(k,b,n,\Gamma)$ and $H(n_f,\Gamma)$, respectively; pricing functions, $r(\Gamma)$ and $w(\Gamma)$; an interest rate $R(\Gamma)$; and sequence of transfers, $\{T_{jt}\}_{t=0}^{\infty}$, such that:

1. taking the pricing functions, interest rate, and matching rate, $m(\cdot)$, as given, $J(k,b,n,\Gamma)$ satisfies the household Bellman equation, (3.17), with k', s, and b' the associated policy functions.

2. taking the pricing functions, interest rate, and matching rate, $\mu(\cdot)$ as given, $H(n_f,\Gamma)$ satisfies the firm Bellman equation, (3.12), with k_f and v the associated policy functions.

3. All markets clear. This requires that $k = k_f = K$, $n = n_f = N$, $v = V$, $s = S$, $b = B$. In addition, it requires that the market for international bonds clears:

$$B_1 + B_2 = 0 \tag{3.23}$$

and so does the world-wide market for the consumption-investment good:

$$\sum_{j=1}^{2}[K_j' + C_j + G_j] = \sum_{j=1}^{2}\big[[1 + R(\Gamma)]K_j + F_n(K_j, N_j)N_j - pV_j\big]. \tag{3.24}$$

4. Given the sequences of government expenditures $\{G_{jt}\}_{t=0}^{\infty}$ and search subsidy rates τ_j, $j = 1, 2$, the transfers, $\{T_{jt}\}_{t=0}^{\infty}$, satisfy the two countries' government budget constraints.

4. Unemployment and International Indebtedness in the Steady-state

The steady state of the equilibrium dynamic system is denoted by $\mathbf{S}_j(c_j^\star, \ell_j^\star, k_j^\star, b_j^\star, s_j^\star, x_j^\star)$ for $j = 1, 2$ and characterized by the following equations derived from the equilibrium conditions for each country (see section 3.5):

$$\frac{(R+\theta)(1-\tau(1-\lambda))x^\star}{m(x^\star)} + x^\star\lambda = \frac{(1-\lambda)F_n(k^\star, n^\star)(1-\tau)}{p}, \tag{4.1}$$

$$\frac{\Psi_\ell}{\Psi_c} = \frac{\lambda((1-\lambda)\tau F_n(k^\star, n^\star) + px^\star)}{(1-\lambda)(1-\tau(1-\lambda))}, \tag{4.2}$$

$$1 = \beta(c^\star, \ell^\star)(1+R), \tag{4.3}$$

$$c^\star = -ps^\star x^\star - G + F_n(k^\star, n^\star)n^\star + R(b^\star + k^\star), \tag{4.4}$$

$$s_i^\star = \frac{\theta n^\star}{m(x^\star)}, \tag{4.5}$$

$$\Psi(c^\star, \ell^\star) = \frac{u(c^\star, \ell^\star)}{1 - \beta(c^\star, \ell^\star)}, \tag{4.6}$$

where $x^\star = v^\star/s^\star$. The equations (4.1)-(4.6) determine a unique steady state for each country.

Equation (4.3) allows to express the steady state consumption level in each country as a function of leisure and world interest rates only, $c^\star = c(\ell^\star, R^\star)$. Since endogenous discount factor exhibits increasing marginal impatience in consumption and leisure ($\partial\beta/\partial c < 0$ and $\partial\beta/\partial\ell < 0$), the steady state consumption level is positively correlated to the world interest rate. Similarly, an increase (decrease) in leisure results in a decrease (increase) in the steady state consumption level.

Equation (4.1) solves for $x^\star = x(R^\star, \tau_i)$ since $F_n^\star = F_n(R)$ and $m = m(x^\star)$. First, since unemployment subsidy is paid only to agents that are engaged in active search, labor market tightness parameter is decreasing in τ. Secondly, it can be shown that market tightness parameter, x is decreasing in R (see notes in appendix).

Note that equation (4.2) represents the marginal rate of substitution (MRS) between leisure and consumption and solves for the steady state level of leisure as a function of R and τ only. This implies, $\partial\ell/\partial R > 0$ and $\partial\ell/\partial\tau < 0$ [proof in Shi's notes - Appendix]

The steady state level of employment is determined by:

$$n^\star(R^\star, \tau) = 1 - \ell(R, \tau) - s(R, \tau) = \frac{1 - \ell^\star(R, \tau)}{1 + \theta/m(x^\star(R, \tau))}. \tag{4.8}$$

Since $\partial\ell/\partial R > 0$ and $\partial x/\partial R < 0$ it is obvious that the steady state level of employment is decreasing in R. The effect of replacement rates, τ, on employment ($\partial n/\partial\tau$) is important, but is ambiguous analytically. On the one hand, an increase in τ increases the reservation wage, for given R, and hence increases labor force participation ($\partial\ell/\partial\tau < 0$). On the other hand, an increase in τ makes the labor market tighter ($\partial x/\partial\tau < 0$), reducing the matching rate for each unemployed agent and hence reduces n. Furthermore, in an open economy environment in cases when the world interest rates respond to changes in τ, employment levels in both countries are affected.

Lemma 1: An increase in τ_2 affects the steady state unemployment rate in country 1 if and only if the steady state interest rate responds to τ_2. Moreover, $\partial \mathrm{un}_1/\partial\tau_2 < 0$ if and only if $\partial R/\partial\tau_2 < 0$.

Proof: The steady sate unemployment rate in country 1:

$$\text{un}_1 = \frac{s_1}{s_1 + n_1} = \frac{\theta n_1/m_1}{\theta n_1/m_1 + n_1} = \frac{\theta}{\theta + m(x_1)}$$

Thus,

$$\frac{\partial \text{un}_1}{\partial \tau_2} = -\frac{\theta}{(\theta + m_1)^2}\frac{\partial m_1}{\partial x_1}\frac{\partial x_1}{\partial \tau_2} = -\frac{\theta}{(\theta + x_1^\alpha)^2}\alpha x_1^{\alpha-1}\frac{\partial x_1}{\partial R}\frac{\partial R}{\partial \tau_2} \quad \text{QED}$$

When exogenous (fixed) discount rate is used changes in unemployment benefit rates in one country will have no effect on foreign unemployment level since $\partial R/\partial \tau_2 = 0$.

The effects of replacement rates on welfare are ambiguous. Although an increase in unemployment replacement rates stimulate an increase in consumption leading to higher levels of utility, an increase in τ leads to an increase in labor force participation rate resulting in lower levels of leisure. A relationship between welfare and world interest rates has no ambiguity since consumption and leisure are both increasing in interest rates.

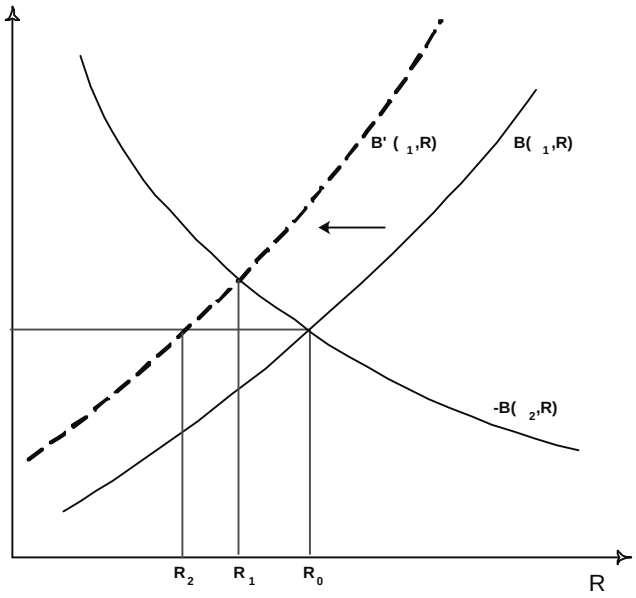
The direction and levels of foreign capital flows between two countries are characterized by foreign bond holdings, b_j. Equation (4.4) allows us to express the capital market clearing condition ($b_1 = -b_2$) as follows:

$$c_1^\star(\ell_1^\star(R,\tau_1),R) + ps_1^\star(R,\tau_1)x_1^\star(R,\tau_1) + G_1 - F_{n1}(R,\tau_1)n_1^\star(R,\tau_1) - k_1^\star(R,\tau_1)R =$$

$$-(c_2^\star(\ell_2^\star(R,\tau_1),R) + ps_2^\star(R,\tau_2)x_2^\star(R,\tau_2) + G_2 - F_{n2}(R,\tau_1)n_2^\star(R,\tau_2) - k_2^\star(R,\tau_2)R). \quad (4.9)$$

Since an increase in R affects both output and consumption in opposite directions, its effect on $b^\star(R,\tau)$ is ambiguous. If the effect of R on consumption dominates that on output, then $b^\star(R,\tau)$ is an increasing function of R. Under similar conditions, $b^\star(R,\tau)$ is increasing in τ in cases when $\partial n/\partial \tau < 0$. We will use these assumptions throughout the remaining parts of the paper including the numerical exercises. Under these assumptions we can show that $\partial R/\partial \tau < 0$ (see figure 4.1).

FIGURE 4.1. EFFECT OF AN INCREASE OF UNEMPLOYMENT BENEFIT RATE ON CAPITAL FLOWS



A STEADY STATE RELATIONSHIP BETWEEN THE LEVELS OF FOREIGN BOND HOLDINGS IN EACH COUNTRY AND WORLD INTEREST RATES (EQUATION (4.9))

An increase unemployment replacement rates in country 1 leads to higher levels of bond holdings for given interest rate and is represented by a shift from B to B' in Figure 4.1. The increase in bond holdings results in a downward pressure on interest rates (R falls from R_0 to R_1 in Figure 4.1). Since, $\partial x/\partial R < 0$ and $\partial x/\tau < 0$, the fall in the interest rates mitigates the negative effect of τ_1 on x_1. Furthermore, since effects of τ on unemployment rate is determined by:

$$\frac{\partial \mathrm{un}_1}{\partial \tau_1} = -\frac{\theta}{(\theta + m_1)^2} \frac{\partial m_1}{\partial x_1} \frac{\partial x_1}{\partial \tau_1},$$

a decrease in interest rates mitigates the direct positive effect of τ_1 on un_1.

If a country is closed ($b_j = 0$), the interest rate would fall further to R_2, producing even larger mitigation effects on unemployment. Thus, *as a result of an increase in unemployment replacement rate the unemployment rate will rise more in an open economy environment than in a closed economy.* At the same time, in an open economy case, the fall in the equilibrium interest rate stimulates firms in a foreign country to increase va-

cancy postings resulting in an increase in x_2. Therefore, *an increase in unemployment replacement rate will result in a reduction in the unemployment rate in a foreign country.* Thus, as a result of an increase in τ in country 1, *the unemployment gap between the two countries* ($\text{un}_1 - \text{un}_2$) *is more significant not only because of a higher increase in* un_1 *but also as a result of a fall in* un_2.

Similarly it is possible to characterize the long run unemployment rates for countries that move from closed to an open economy environment by opening their capital markets. In autarky, two identical countries with different unemployment replacement rates, $\tau_1 < \tau_2$, will have different domestic interest rates, $r_1 > r_2$, and unemployment rates, $\text{un}_1 < \text{un}_2$. Once countries move to an open economy environment, access to foreign bond market and no-arbitrage condition ($r_1 - \delta = r_2 - \delta = R$) imply convergence of interest rates between two countries, in particular: $\Delta r_1 < 0$, $\Delta r_2 > 0$ and $B_1 < 0$ and $B_2 > 0$. Since

$$\frac{\partial \text{un}_j}{\partial r_j} = -\frac{\theta}{(\theta + m_j)^2} \frac{\partial m_j}{\partial x_j} \frac{\partial x_j}{\partial r_j} \qquad \text{and} \qquad \frac{\partial x_j}{\partial r_j} < 0,$$

different domestic interest rate adjustment results in diverging unemployment rates in the steady state after opening of capital markets. Thus, *an opening of capital markets in two identical economies with different unemployment replacement rates results in widening of the unemployment gap between the two and opening of capital account deficit for a high benefit country.*

5. Quantitative analysis of the model

5.1 Parametrization

The functional form of instantaneous individual utility function for each household in country j is represented by:

$$u(c, \ell) = \frac{c^\sigma}{\sigma} - \varphi \frac{(1-\ell)^\rho}{\rho}, \tag{4.1}$$

This utility function satisfies the following conditions: $u(\cdot) < 0$, $u'(\cdot) > 0$, $u'(0) = \infty$, and $\ln(-u(\cdot))$ is convex. Individual risk aversion parameter σ is set to -2.The base value of ρ is set to 3.5 to obtain a labor supply elasticity $\epsilon = 1/(\rho - 1) = 0.4$, which falls in the range in

Killingsworth (1983). The value of φ is found by matching the steady state of labor force participation, $\bar{n} + \bar{s}$, with the realistic value of around 0.68.

As indicated previously, we restrict our attention to a case in which preferences exhibit weak separability in the sense of Shi (1994). Generally there are three cases when the condition (3.2) of weak separability is satisfied:

(i) constant rate of time preference, $\beta_c = \beta_l = 0$;

(ii) Epstein-Hynes specification, u constant, $u_c = u_\ell = 0$;

(iii) original Uzawa (1968) specification, $\beta = \beta(u)$.

For calibration purposes we consider Uzawa (1968) type preferences. The functional form of endogenous time preference parameter in country j is given by:

$$\beta(c, \ell) = \beta(u(c, \ell)) = \exp(-v) \quad \text{where} \quad v(c, \ell) = \zeta \ln(\iota + u(c, \ell))$$

such that $v(\cdot) < 0$, $v'(\cdot) > 0$ and $v''(\cdot) < 0$. The parameter value for the time preference coefficient ζ is chosen to match the steady state annual interest rate of approximately 4%.

Each firm uses labor and capital as inputs in Cobb-Douglas production function:

$$y = F(k, n) = Ak^{\gamma} n^{1-\gamma}. \tag{4.3}$$

The capital share, γ, in the production function is set to 0.33. Depreciation is set to 0.025, a widely used value in RBC literature Hansen (1985). Technology parameter, A, is set to 1. Government spending, G, is chosen to be approximately 20% of a steady state output.

Parameters related to labor search are selected as follows. First, quarterly rate of transition from employment to unemployment, θ, is set to 0.05 as in Shi and Wen (1999). This value implies that the steady state duration of unemployment of around $1/m(\bar{x}) = 1.27$, which roughly matches the average quarterly unemployment duration in the postwar U.S. data (Layard et al 1991). Second, the unit cost of vacancy posting, p, is chosen to match a steady state unemployment rate $\bar{s}/(\bar{s}+\bar{n})$ with the realistic value of approximately 0.05. Third, the base value of elasticity of job vacancies, α, is 0.6 as indicated by Blanchard and Diamond (1989) and the base value for λ is 0.4 as used by Shi and Wen (1999)[1]. The

[1] In the model the number of job matches per search, m, depends on search effort s, and the number

parameter values are summarized in Table 5.1.

TABLE 5.1 BASE VALUES OF PARAMETERS

	Household	
σ	relative risk aversion coefficient	-2
ρ	elasticity of substitution	3.5
ζ	time preference coefficient	0.5
φ	constant term	3.8
	Firm	
A	Technology parameter	1
γ	Capital share in production function	0.33
δ	Depreciation rate of capital	0.025
	Labor market	
θ	Labor separation rate	0.05
α	Elasticity in job vacancy	0.6
λ	Nash bargaining power of workers	0.4
v	price of a vacancy posting	1.1
	Government	
G	Government spending	1/5
τ	Unemployment subsidy rate	0.45

5.2: Effects of Unemployment Subsidy in a steady state

First, we look at a closed economy that has no access to international bond markets. Table 4.2 summarizes steady state values for employment, search, interest rates, capital and output for different levels of unemployment subsidy τ.

of job matches per job vacancy μ, depends on job vacancies v. In household and firm optimization problems this dependency is not taken into account. In general the search equilibrium will not deliver efficient allocations unless these labor market externalities are internalized with specific matching functions and wage bargaining rules. With the Cobb-Douglas matching function these conditions are internalized by a single condition: $\lambda = 1 - \alpha$

TABLE 5.2 ROLE OF UNEMPLOYMENT SUBSIDY IN A CLOSED economy

Variable	$\tau = 0$	$\tau = .25$	$\tau = 0.45$	$\tau = 0.75$
Employment	.63160	.62983	.62719	.61649
Search	.02570	.03043	.03649	.05773
Unemployment	.03909	.04609	.05499	.08563
Capital	8.8250	8.8859	9.0079	9.6752
Tightness	1.4097	1.0587	.77650	.35134
Interest rate	.05325	.05291	.05227	.04921
Bond holings	0	0	0	0
Output	1.4687	1.4691	1.4713	1.4878
Wage	1.4510	1.4702	1.4937	1.5694
Reservation Wage	1.3641	1.3930	1.4260	1.5216

An increase in unemployment replacement rates increases labor search intensity and decreases employment rate resulting in a steady increase in unemployment rate (tightening of labor market). An increase in search intensity is directly linked to the condition that unemployment benefits are paid only to ones who are actively engaged in labor search. Subsequently, it results in an increase in individual reservation wages. As wages are set by Generalized Nash bargaining between workers and firms, an increase is reservation wage (RW) leads to an increase in wages (here $F_n > w > RW$). Higher wages, in turn, result in an increase of household members who substitute employment for leisure (fall in n).

Next we consider what would happen if a closed economy described above opens its capital markets. The calculations for the open economy case are conducted as follows. We consider two identical countries with unemployment benefit rates being the only parameter different between the countries. Two cases are considered: (i) a country (home) with $\tau_h = .45$ opens its capital market to a country (foreign) with higher unemployment replacement rate $\tau_f = .75$ and (ii) home country opens capital markets with a country having lower replacement rate $\tau_f = .25$. Results are summarized in Table 4.3.

TABLE 5.3 ROLE OF UNEMPLOYMENT SUBSIDY IN AN OPEN ECONOMY

Variable	Autarky $\tau_c = 0.45$	Home $\tau_h = 0.45$	Foreign $\tau_f = 0.25$	Home $\tau_h = 0.45$	Foreign $\tau_f = 0.75$
Employment	.62719	.63054	.62648	.63062	.61308
Search	.03649	.03041	.03651	.03641	.05790
Unemployment	.05499	.04602	.05507	.05459	.08629
Capital	9.0079	8.9754	8.9175	9.4614	9.1982
Tightness	.77650	1.0615	.77443	.78659	.34647
Interest rates	.05226	.05258	.05258	.05073	.05073
Bond holdings	0.	-.1181	.1181	-.6123	.6123
Output	1.4713	1.4750	1.4655	1.5002	1.4585
Wage	1.4937	1.4751	1.4889	1.5171	1.5450
Reservation Wage	1.4260	1.3981	1.4210	1.4500	1.4966

A key difference between open and closed economies is the fact that in an open economy households can buy or sell foreign bonds b. As described previously, high unemployment replacement rates result in higher wages and unemployment transfers. In an open economy, households will channel their savings to buying foreign bonds and domestic capital stock. Therefore, we observe that a country with higher unemployment replacement rates becomes a net buyer of foreign bonds. The amount of foreign bond holdings increase as the difference between unemployment replacement rates increases. For a country with high search subsidy, the capital outflow is reflected by a decrease in domestic capital stock k, that has a direct effect on total output.

In an open economy environment, the changes in domestic labor market in home country depend on the search subsidy in the foreign country. Firstly, if a foreign country has lower unemployment replacement rate, employment level and search intensity increases leading to an increase in unemployment rate (comparing to a case when capital is immobile across countries). Secondly, if a foreign country has higher replacement rates - unemployment will fall. Thus, in presence of capital movements between two countries the difference in unemployment rates will be more significant than in a case of closed economies. Table 5.4 compares the *unemployment gaps* between the two countries for various levels of τ_j.

TABLE 5.4 UNEMPLOYMENT GAP

Closed Economies		
Replacement rates	Unemployment rates	$un_1 - un_2$
τ_1=.25, τ_2=.45	un_1=.04609, un_2=.05499	-.8905 %
τ_1=.45, τ_2=.75	un_1=.05499, un_2=0.8563	-3.0640 %
τ_1=.25, τ_2=.75	un_1=.04609, un_2=.08563	-3.9545 %
Open Economies		
Replacement rates	Unemployment rates	$un_1 - un_2$
τ_1=.25, τ_2=.45	un_1=.04602, un_2=.05508	-.9056 %
τ_1=.45, τ_2=.75	un_1=.05459, un_2=.08629	-3.1700 %
τ_1=.25, τ_2=.75	un_1=.04569, un_2=.08643	-4.0743 %

Firstly, it is clear that the *unemployment gap* between two countries increases as differences in unemployment replacement rates become larger. Secondly, the *unemployment gap* increases as economies open their capital markets. For example, in case one country has $\tau_1 = 0.25$ and other one $\tau_2 = 0.75$, the *gap* increases from 3.9% to 4.07%. Thus, we show that even when labor is immobile between the countries, opening of capital markets can affect the labor market structure in two countries. In particular, unemployment rates in two countries that have different unemployment replacement rates diverge after opening of capital markets.

Conclusions

This paper focused on effects of unemployment replacement rates in an open economy in presence of incomplete capital markets. It is shown that presence of international capital mobility contributes to an increase in the unemployment gap arising due to differences in unemployment benefit replacement rates. Moreover, when capital markets are opened, high benefit countries experience both an increase in the unemployment rate and an outflow of capital, and low benefit countries experience both a reduction in the unemployment rate and an inflow of capital. Therefore, it is argued that capital outflows from Europe

to the United States throughout the 1980ies have contributed to the persistence in the unemployment gap.