EFFECTS OF EXCHANGE RATE AND TARIFFS 
ON AN OPEN ECONOMY OF SCARCITY OF CAPITAL

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Abstract. In this paper, the impact of tariffs and exchange rate on consumption and investment in an open economy of scarcity of capital is analysed. The dynamics and market price of capital, and the solution of foreign asset holding of the firm are discussed. Particular attention is also devoted to the social welfare aspects.

§ 1 The Model

We consider an economy, which is specialized in the production of a single tradable commodity. The economy is also characterized by an exogenous growing population \( N = N_0 e^{\eta} \) \((N_0 > 0, \eta > 0)\). The labor force is a constant fraction of the population and the technical progress is subsumed into population growing. This paper assumes that the labor force is equal to population, i.e. the fraction is 1. The representative firm (or household) in this economy produces domestic output \( y(t) \) by means of a production function \( F(K(t), N(t)) \) with capital \( K(t) \) and labor force \( N(t) \) as inputs. This function is assumed to have the usual neoclassical properties of positive, but diminishing, marginal products and constant returns to scale. The firm, however, also consumes the above domestic goods and another goods imported from abroad. The economy is too small to influence the terms of trade. It can borrow or lend as much as it wants at given world interest rate, though subject to an intertemporal budget constraint. However, by being not able to influence the terms of trade, the world interest rate relevant for the economy is exogenously determined and given.

The capital stock \( K(t) \) (measured in the terms of foreign goods) which is imported from abroad depreciates at the constant rate \( \delta \). Expenditure on a given increase in the capital stock involves adjustment cost \( \phi(I(t)/K(t)) \). Because of the depreciating capital stock,
the firm faces the standard capital accumulation constraint
\[
\frac{dK(t)}{dt} = I - \delta K(t),
\]
(1.1)
where \( I \) is the rate of investment.

Being a risk-aversion firm, the firm also holds nominal money balance \( M(t) \) (measured in terms of domestic goods) and accumulates foreign assets \( B(t) \) (in units of foreign output) at an exogenously given world interest rate \( r \). Then the wealth of the firm (measured in the terms of the domestic goods)
\[
A(t) = \sigma(B(t) + K(t)) + M(t),
\]
(1.2)
where \( \sigma \) is the exchange rate.

Then the following equation (1.3) describes the firm's instantaneous budget constraint
\[
\frac{dA(t)}{dt} = \sigma((1 - \tau_y)Y(t) - (\phi(I/K(t)) + I)(1 + \tau_i) + rB(t) - (1 + \tau_c)C^*(t)) + Z - C^d(t) - \pi M(t)/p(t),
\]
(1.3)
where \( \tau_y \) is the output taxation levied by government, \( \tau_i \) and \( \tau_c \) are tariffs on investment and consumption respectively, \( \sigma \) is the exchange rate, \( C^*(t) \) and \( C^d(t) \) are the consumption of domestic goods and imported goods by the firm respectively, \( Z \) is a government transfer, \( p(t) \) is the price level in the economy, \( \pi \) is the inflation rate in the economy.

Now we introduce per capita variables, viz, \( a(t) = A(t)/N(t), b(t) = B(t)/N(t), k(t) = K(t)/N(t), i(t) = I(t)/N(t), c^a(t) = C^a(t)/N(t), c^d(t) = C^d(t)/N(t), z = Z(t)/N(t) \).

However, \( m(t) = M(t)/[N(t)p(t)] \) is the real per capita money balance. The relation between per capita output \( y(t) \) and the per capita capital stock \( k(t) \) is \( y(t) = f(k(t)) \) with \( f' > 0 \) and \( f'' < 0 \). Henceforth, given the initial foreign asset holding \( b_0 \), the firm maximizes the present values of the utility stream
\[
w = \int_0^\infty (u(c^d, \sigma c^a) + v(m))e^{-\rho t}dt.
\]
(1.4a)
Subject to the following constraints
\[
\frac{da(t)}{dt} = \sigma((1 - \tau_y)y(t) - (i + i\phi(i/k))(1 + \tau_i) + rb(t) - (1 + \tau_c)c^*(t)) + z - c^d(t) - \pi m - a,
\]
(1.4b)
\[
\frac{dk(t)}{dt} = i - \delta k - nk,
\]
(1.4c)
where \( \rho \) is a constant subjective discount rate, \( w(t) = u(c^d, \sigma c^a) + v(m) \) is the instantaneous utility function of the firm measured in the terms of domestic goods. The function is assumed to be additively separable in goods and money balance, and the two goods are taken to be Edgeworth complementary, so that \( \frac{\partial^2 u}{\partial c^d \partial c^a} > 0 \) \([1] \), other two assumptions are \( \frac{\partial^2 u}{\partial c^d^2} < 0 \) and \( \frac{\partial^2 u}{\partial c^a^2} < 0 \). The function \( \phi(i/k) \) is specified to be a nonnegative, linearly homoge-