The Monetary Approach to International Macroeconomics

Professor George Alogoskoufis
Athens University of Economics and Business

The Monetary Approach

- The monetary approach is one of the central pillars of international macroeconomics. Its point of departure is the so called monetary model, which identifies the factors affecting long-term nominal exchange rates. The monetary model was originally used as a framework of analysis of the balance of payments in a fixed exchange rate regime (Frenkel and Johnson 1976), and then as a framework for analysis of the determination of nominal exchange rates in a flexible exchange rate regime (Frenkel and Johnson 1978).

- The basic monetary approach assumes that there is full flexibility in prices and focuses on the equilibrium conditions in the money market and the international foreign exchange markets. Although this is basically an ad hoc model, like the Mundell-Fleming model, many of its theoretical properties are confirmed by inter-temporal optimization models in monetary economies (see Lucas 1982).

Purchasing Power Parity

- A key component of the monetary approach is the concept of *purchasing power parity*. The idea originated from the early 19th century, and one can find it in the writings of Ricardo. The idea was revived in the early 20th century by Cassel (1921).

- The approach of Cassel starts with the observation that the exchange rate is the relative price of two currencies. Since the purchasing power of the domestic currency is $1/P$, where P is the domestic price level and the purchasing power of the foreign currency is $1/P^*$, where P^* is the foreign price level, the relative price of two currencies should reflect their relative purchasing power. In this case, it should follow that,

$$S = P / P^* \qquad\qquad s = p - p^*$$

Purchasing Power Parity and the IS Curve

$$y = \delta(s + p^* - p) + \gamma y - \sigma i + g$$

The theory of purchasing power parity can be derived from the IS curve of an open economy, when the elasticity of aggregate demand with respect to the real exchange rate tends to infinity.

As δ tends to infinity, aggregate demand will be finite only if the logarithm of the real exchange rate $s+p^*-p$ tends to zero, that is if purchasing power parity is satisfied.

If the elasticity of aggregate demand with respect to the real exchange rate is very high, then there cannot be large deviations between domestic and international prices, expressed in a common currency, as even small deviations would produce large changes in aggregate demand. Effectively, the theory of purchasing power parity asserts that domestic and foreign goods are perfect substitutes.

The Purchasing Power Parity Approach

- The purchasing power theory approach essentially requires that the real exchange rate should be constant. However, this prediction is generally rejected by empirical evidence. Real exchange rates are not constant, but display considerable fluctuations. Moreover, there seems to be a strong positive correlation between nominal and real exchange rates, which is not consistent with purchasing power parity.

- A variant of this approach, which we will examine below, allows fluctuations in the real exchange rate and treats purchasing power parity as a theory determining the long-term real exchange rate.

- In any case, for the monetary model with fully flexible prices, the assumption of purchasing power parity is central.

The Monetary Approach to the Balance of Payments

- The monetary approach to the balance of payments (Frenkel and Johnson 1976), uses the monetary model to explain the behavior of the balance of payments, under a regime of fixed exchange rates.

- Consider a small open economy that maintains a constant exchange rate through interventions of its central bank in the foreign exchange market.

- The money supply is determined by,

$$M = \mu B = \mu(B_f + B_d)$$

- where *M* denotes the money supply, *B* the monetary base (high powered money), μ the multiplier of the monetary base, B_f net foreign exchange reserves of the central bank, and B_d net domestic credit of the central bank to the public and the banking system.

Equilibrium in the Money Market under Fixed Exchange Rates

$$m = \theta b_f + (1-\theta) b_d$$

$$m - p = \phi y - \lambda i$$

$$i = i^*$$

$$\bar{s} = p - p^*$$

$$m = \bar{s} + p^* + \phi y - \lambda i^*$$

Main Predictions of the Monetary Approach to the Balance of Payments

$$b_f = \frac{1}{\theta}\left[\bar{s} + p^* + \phi y - \lambda i^* - (1-\theta) b_d\right]$$

- A devaluation (increase in *s*), a rise in the international price level, an increase in domestic output and income and a reduction in international nominal interest rates, increase the demand for money, and, for given domestic credit, cause increases in foreign reserves. The increase in foreign exchange reserves will occur through surpluses in the balance of payments.

- On the other hand, if there is an expansion in domestic credit expansion, the only result will be a loss of net foreign exchange reserves, as the demand for money will not change. Thus, a domestic credit expansion will cause a deficit in the balance of payments.

The Concept of the Balance of Payments Relevant for the Monetary Approach

- The monetary approach to the balance of payments is not concerned with the determination of the *current account*, but the so-called *official balance.*

- Official balance is none other than the sum of the current account and the capital account, without taking account of changes in the net foreign exchange reserves of the central bank.

- One could call the monetary approach as the monetary approach to the change in foreign exchange reserves of the central bank.

The Monetary Approach to Flexible Exchange Rates

$$m - p = \phi y - \lambda i$$

$$i = i^* + \dot{s}^e$$

$$s = p - p^*$$

$$\dot{s}^e = \frac{1}{\lambda}\left(s - m + \phi y - \lambda i^* + p^*\right)$$

Main Predictions of the Monetary Approach to the Exchange Rate

$$s = m - \phi y + \lambda i^* - p^*$$

- Increases in domestic money supply and international interest rates cause a depreciation of the nominal exchange rate
- Increases in domestic income and the international price level cause an appreciation of the nominal exchange rate.
- In an equilibrium without "bubbles" there can be no expectations of future changes in the exchange rate. The exchange rate, as a non-predefined variable, immediately adjusts to the steady state equilibrium

The Monetary Approach and Real Exchange Rates

- It requires that the real exchange rate is constant, and that as long as domestic inflation differs from international inflation there will be a continuous adjustment of the exchange rate, in order to satisfy the purchasing power parity condition.

- However, empirically, purchasing power parity does not appear to be valid.

- Real exchange rates fluctuate, and their fluctuations are closely related to fluctuations in nominal exchange rates.

- A variant of the monetary model, combines it with the assumption of the gradual adjustment of the price level in order to achieve purchasing power parity in the steady state. Thus, the assumption of purchasing power parity is only assumed to hold in the steady state and not in the short run.

Gradual Adjustment of the Price Level

- Suppose, on the lines of the Dornbusch (1976) model, that the domestic price level adjusts gradually towards its steady state equilibrium level, which is considered to be the price level that satisfies purchasing power parity.

$$\dot{p} = \pi(s + p^* - p)$$

- $\pi > 0$ is a parameter denoting the speed of adjustment of the domestic price level towards its steady state equilibrium, defined as purchasing power parity.

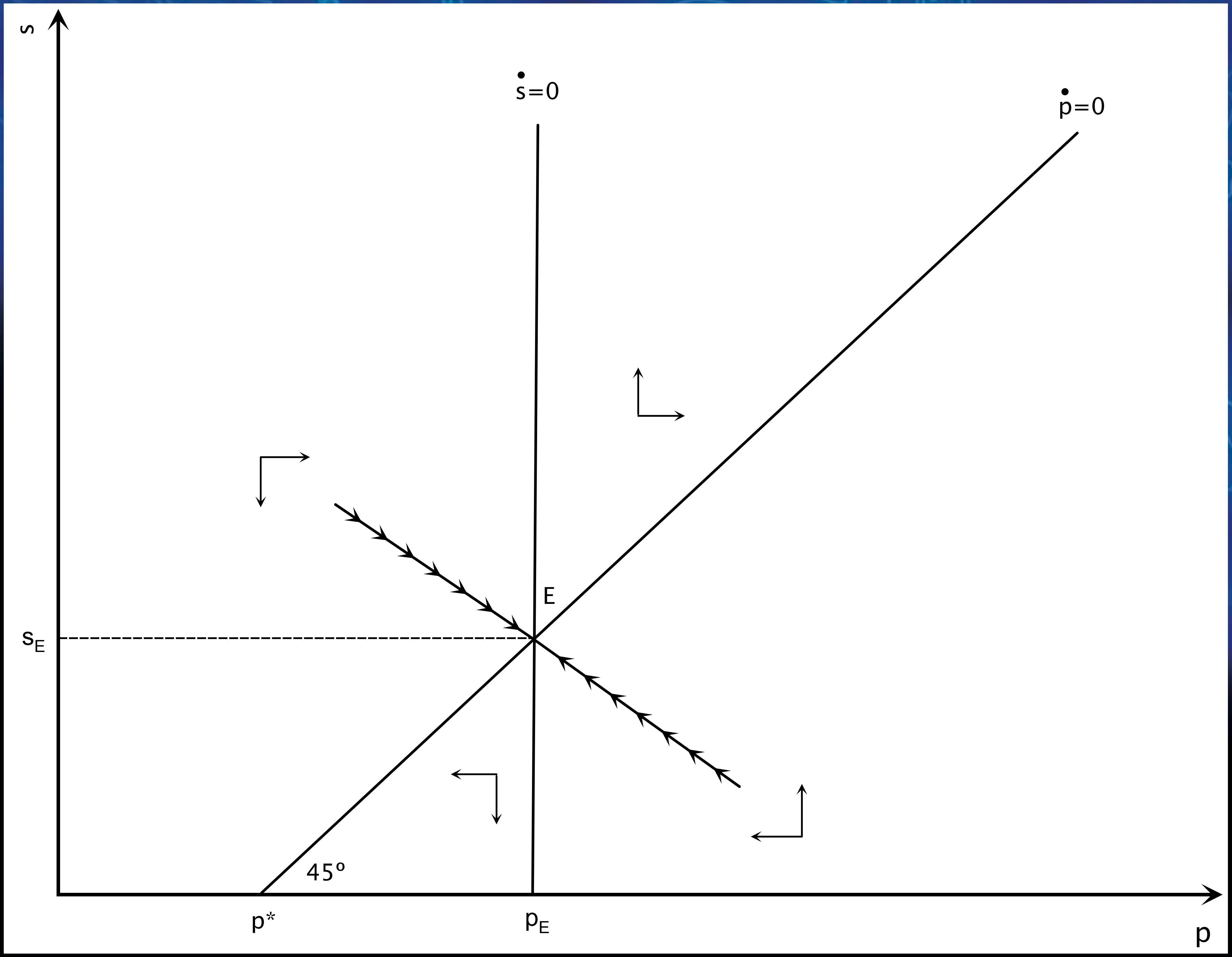
The Monetary Model with Gradual Price Adjustment

$$\dot{p} = \pi(s + p^* - p)$$

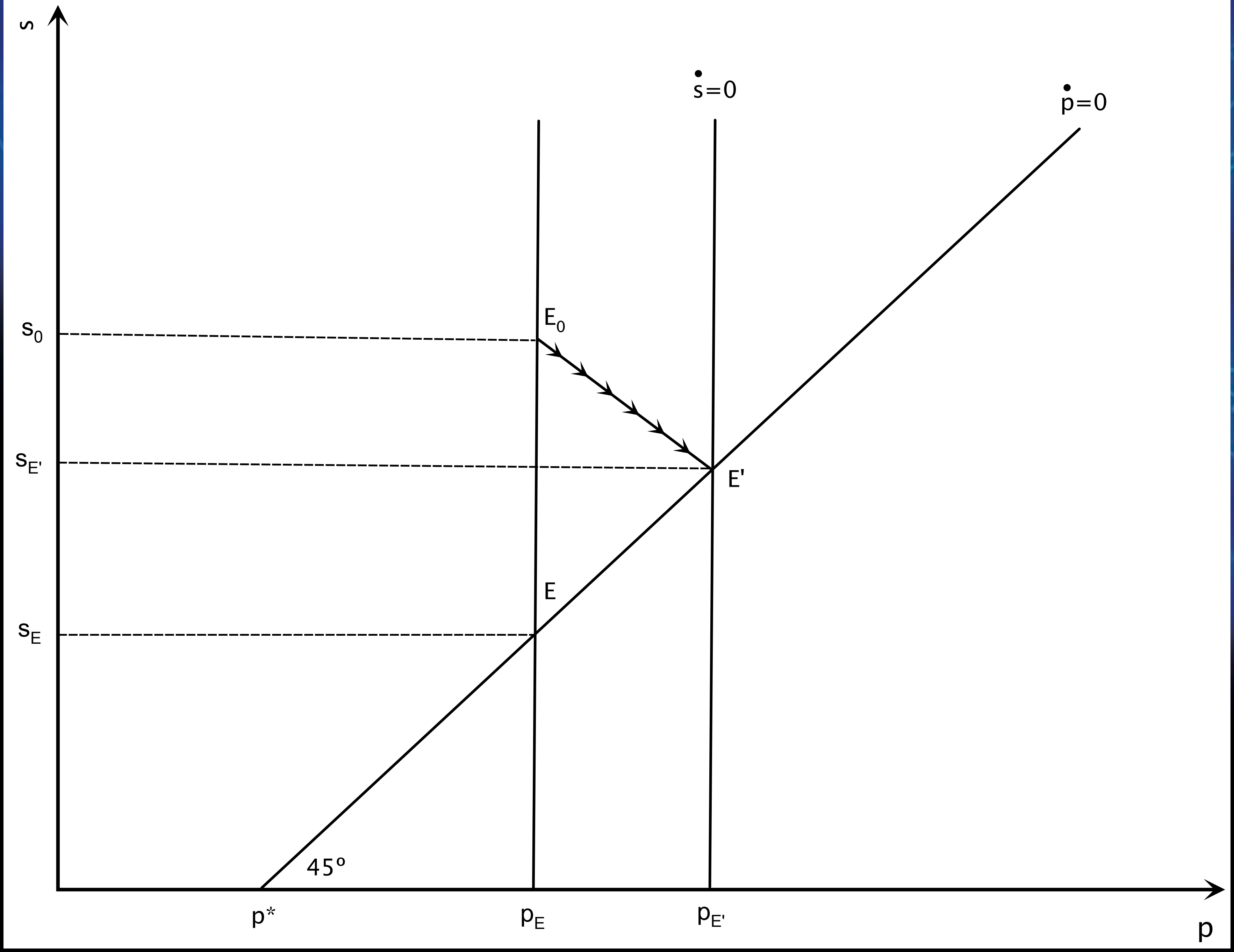
$$\dot{s} = \dot{s}^e = \frac{1}{\lambda}(p - m + \phi y - \lambda i^*)$$

As the domestic price level is a predetermined variable, and cannot adjust in the short run to equilibrate the domestic money market, this role must be played by the domestic nominal interest rate. Since the domestic nominal interest rate can only differ from the international nominal interest rate to the extent that there are expectations of future changes in the exchange rate, the expected and actual change in the exchange rate must be such as to maintain equilibrium in the domestic money market.

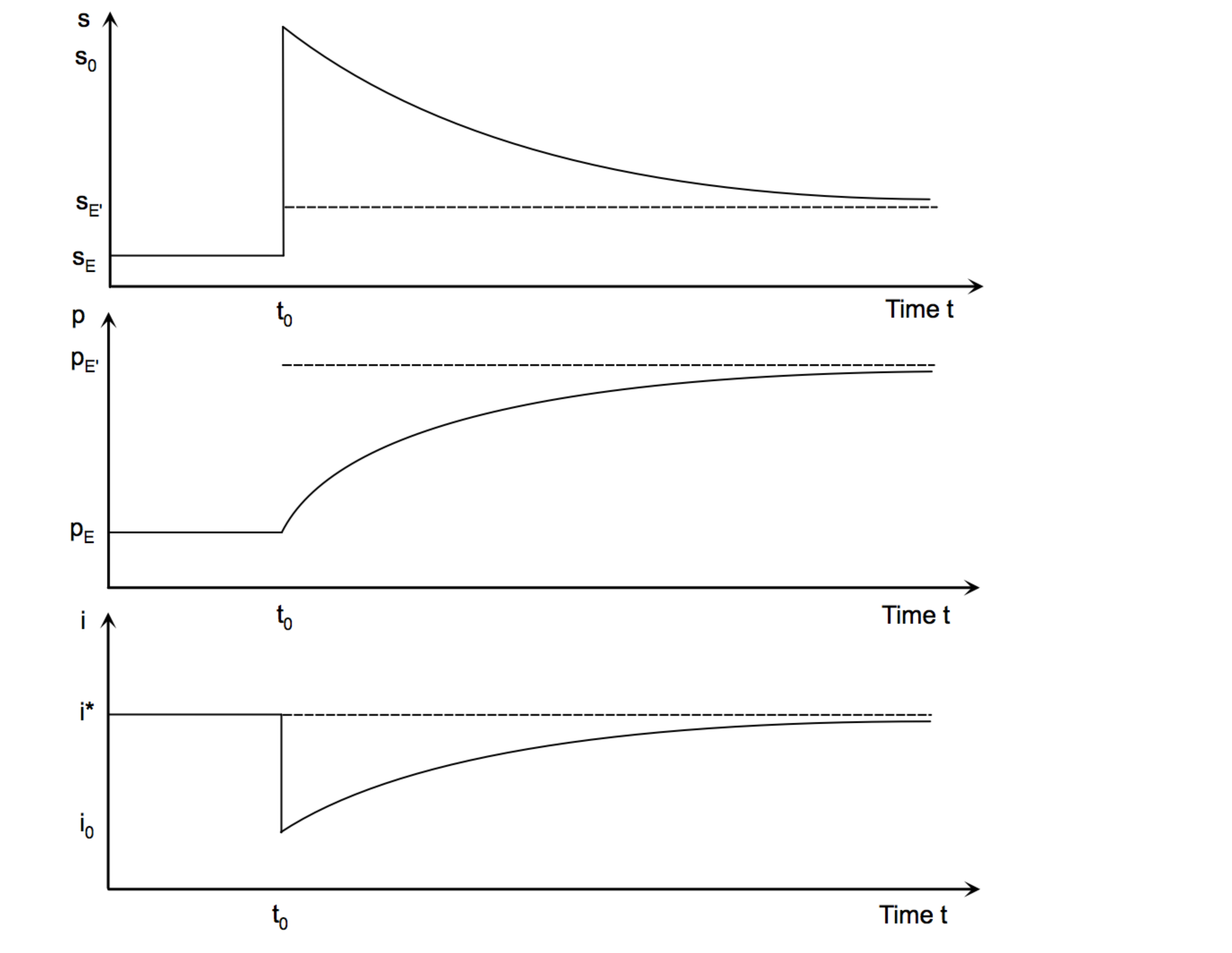
The Monetary Approach with Gradual Adjustment of the Price Level



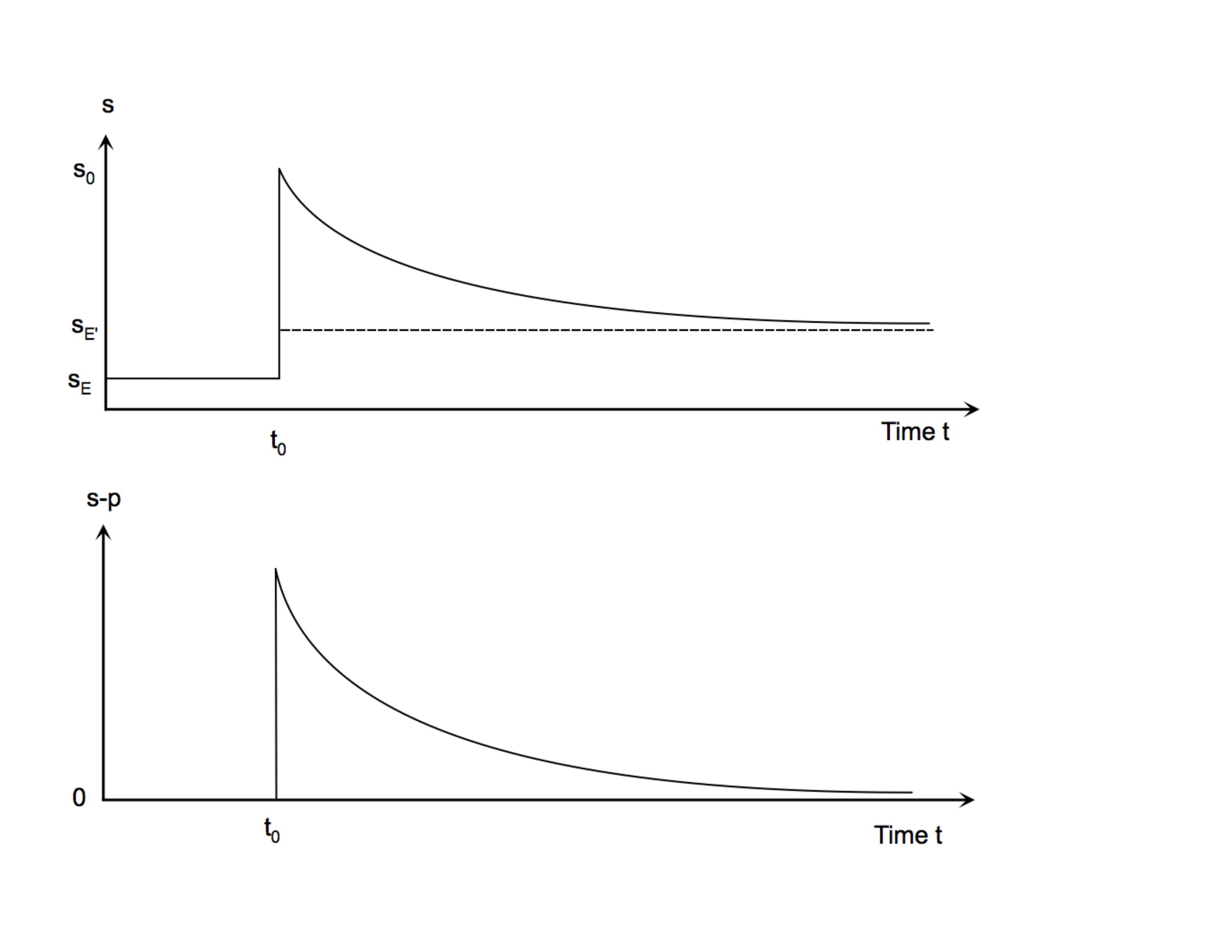
A Permanent Increase in the Domestic Money Supply



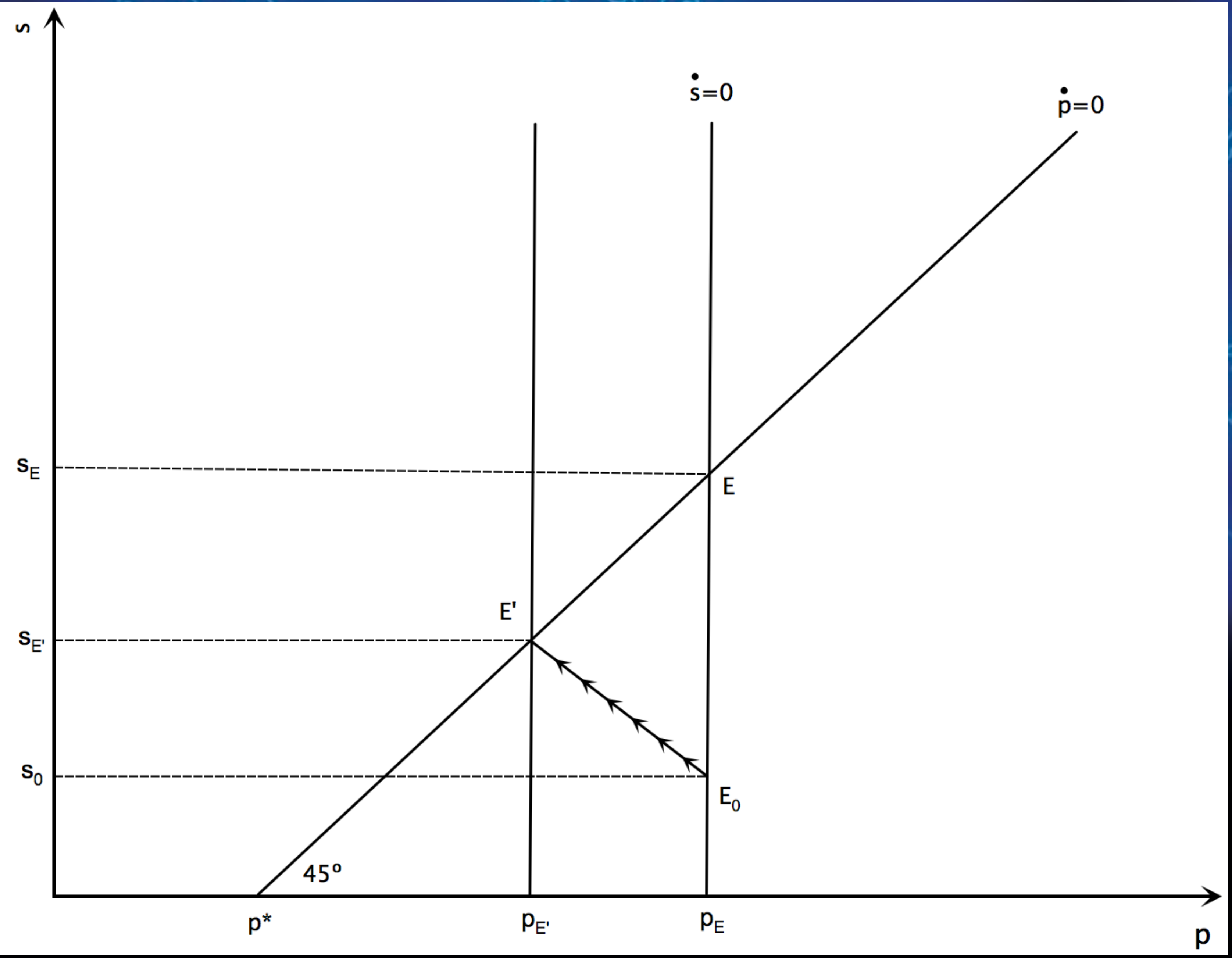
The Dynamic Path of the Nominal Exchange Rate, the Price Level and the Domestic Nominal Interest Rate



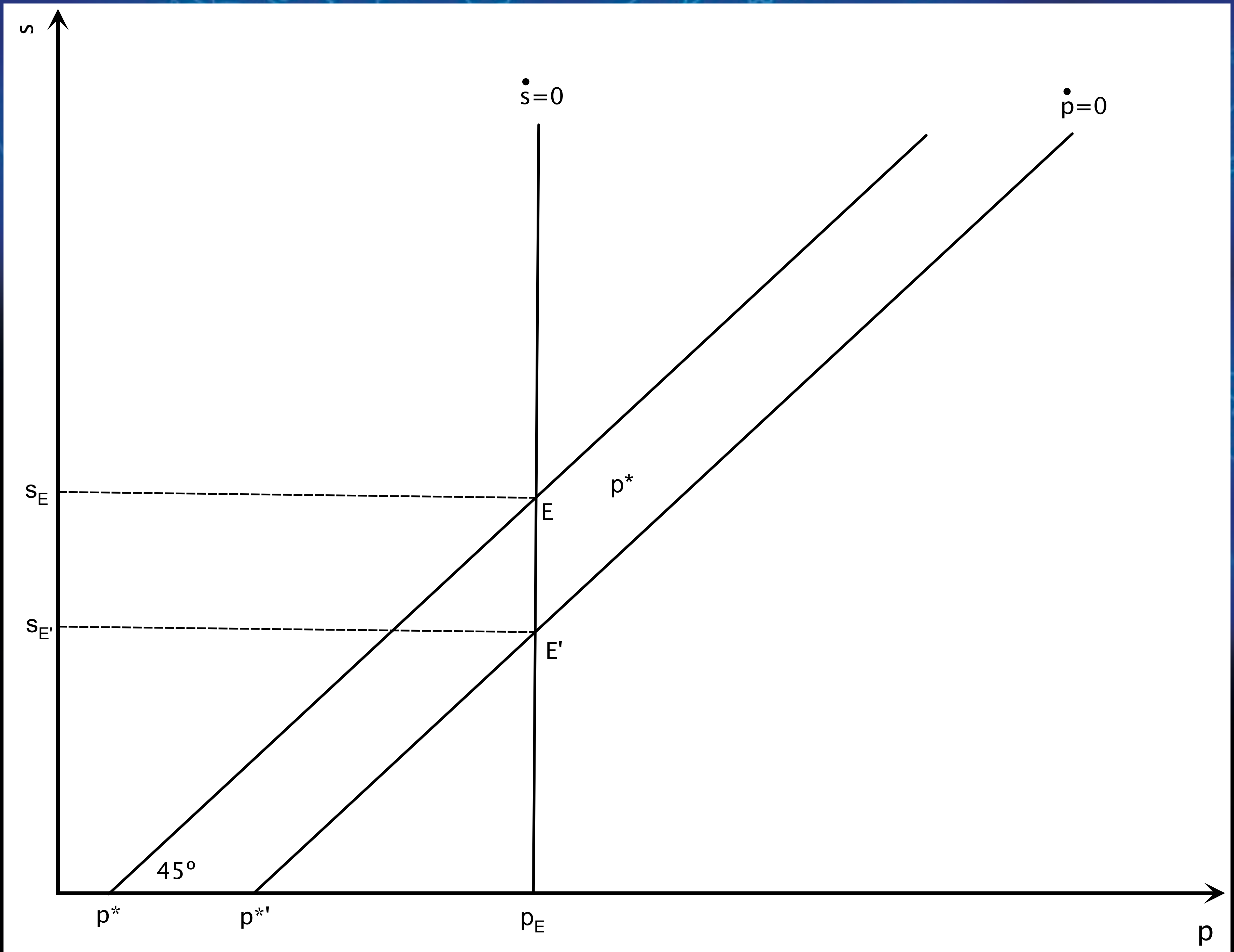
The Dynamic Path of the Nominal and the Real Exchange Rate



A Permanent Increase in Domestic Output



A Permanent Increase in the International Price Level



The Monetary Approach to the Exchange Rate in Discrete Time

The monetary model can easily by adapted to a accommodate discrete time and stochastic shocks. A stochastic version of the monetary model takes the following form,

$$m_t - p_t = \phi y_t - \lambda i_t$$

$$i_t = i_t^* + E_t s_{t+1} - s_t$$

$$p_t = s_t + p_t^*$$

The Determination of the Nominal Exchange Rate

Using the model to eliminate the other two endogenous variables, *i* and *p*, the exchange rate is determined by,

$$s_t = \frac{\lambda}{1+\lambda} E_t s_{t+1} + \frac{1}{1+\lambda}(m_t - \phi y_t + \lambda i_t^* - p_t^*)$$

The current nominal exchange rate is a weighted average of the expected future nominal exchange rate, and the so called *fundamentals f*, which in the case of the monetary model are the exogenous variables that affect the domestic money market. These are the domestic money supply *m*, full employment output *y*, the international nominal interest rate *i** and the international price level *p**.

$$f_t = m_t - \phi y_t + \lambda i_t^* - p_t^*$$

The Rational Expectations Solution for the Nominal Exchange Rate

Through successive substitutions, we get that the rational expectations solution for the exchange rate must satisfy,

$$s_t = \frac{1}{1+\lambda}\sum_{i=0}^{k}\left(\frac{\lambda}{1+\lambda}\right)^i E_t\left(m_{t+i} - \phi y_{t+i} + \lambda i^*_{t+i} - p^*_{t+i}\right) + \left(\frac{\lambda}{1+\lambda}\right)^{k+1} E_t s_{t+k+1}$$

If expectations about the future evolution of the exchange rate grow at a rate which does not exceed *1/λ*, then, it follows that,

$$\lim_{k\to\infty}\left(\frac{\lambda}{1+\lambda}\right)^{k+1} E_t s_{t+k+1} = 0$$

This condition is called a *transversality condition*, and essentially precludes explosive expectations about the future evolution of the exchange rate.

The Fundamental Solution for the Exchange Rate

Taking the limit of the solution, as *k* tends to infinity, and using the transversality condition, the *rational expectations equilibrium solution* for the exchange rate can be written as,

$$s_t = \frac{1}{1+\lambda} E_t \sum_{i=0}^{\infty} \left(\frac{\lambda}{1+\lambda} \right)^i \left(m_{t+i} - \phi y_{t+i} + \lambda i^*_{t+i} - p^*_{t+i} \right) = \frac{1}{1+\lambda} \sum_{i=0}^{\infty} \left(\frac{\lambda}{1+\lambda} \right)^i E_t f_{t+i}$$

This is the so called *fundamental solution* for the exchange rate, as it depends only on the expected future evolution of the fundamentals of the domestic money market.

Properties of the Fundamental Solution

As an asset price, the exchange rate adjusts to equilibrate the domestic money market, through its effects on the domestic price level and the domestic nominal interest rate.

Because of uncovered interest parity, the current equilibrium nominal exchange rate depends on the expected future exchange rate. Thus, the current exchange rate depends on the expected future evolution of all exogenous variables that affect the domestic money market, such as the *domestic money supply*, *full employment output* (which affects money demand), *international nominal interest rates* (which affect domestic nominal interest rates and hence money demand), and *the international price level* (which affects the domestic price level and hence money demand).

Expectations and “Bubbles” for the Exchange Rate

The fundamental solution is not the only solution. A more general solution would take the form,

$$s_t = \frac{1}{1+\lambda} \sum_{i=0}^{\infty} \left(\frac{\lambda}{1+\lambda} \right)^i E_t f_{t+i} + z_t$$

where *z* is an extraneous variable, following a stochastic process defined by,

$$z_t = \frac{1+\lambda}{\lambda} z_{t-1} + \varepsilon_t^z$$

where ε^z is a white noise process, with zero mean and constant variance. *z* is an explosive stochastic process, and is often referred to as a *bubble*. If the exchange rate depends on a bubble, then the bubble will eventually dominate its behavior, and the path of the exchange rate will be explosive.

Closed Form Solutions for the Exchange Rate: Fundamentals follow a Stationary AR(1) Process

In order to say more about exchange rate determination in the monetary model, we need to make assumptions about the exogenous processes driving the fundamentals.

Let us initially assume the the fundamentals follow a stationary AR(1) process, around a constant mean. Thus, the fundamentals are assumed to follow,

$$f_t = (1-\rho) f_0 + \rho f_{t-1} + \varepsilon_t^f$$

The *k* period ahead predictor, i.e the rational expectation about their value *k* periods ahead, depends only on the current fundamentals, according to,

$$E_t f_{t+i} = (1-\rho^i) f_0 + \rho^i f_t$$

The Mean and Variance of the Exchange Rate

Substituting in the fundamental solution, the closed form solution takes the form,

$$s_t = f_0 + \frac{1}{1+\lambda(1-\rho)}\left(f_t - f_0\right)$$

The mean of the exchange rate is equal to the mean of the fundamentals, and the current exchange rate depends on the deviation of the current fundamentals from their mean. The response of the nominal exchange rate to deviations of the current fundamentals from their mean is less than one to one, since λ is positive. Thus, the variance of the nominal exchange rate will be lower than the variance of the fundamentals.

$$Var(s_t) = \left(\frac{1}{1+\lambda(1-\rho)}\right)^2 Var(f_t) < Var(f_t)$$

The Fundamentals Follow a Non-Stationary Process

Let us alternatively assume that the fundamentals follow an integrated AR(1) process, i.e that the change in the fundamentals follows an AR(1) process. This process takes the form,

$$\Delta f_t = \rho \Delta f_{t-1} + \varepsilon_t^f$$

Under such a process, the *k* period ahead predictor of the fundamentals and the closed form solution for the exchange rate take the form,

$$E_t f_{t+k} = f_t + \sum_{i=1}^{k} \rho^i \Delta f_t = f_t + \left(\frac{1-\rho^k}{1-\rho} \right) \rho \Delta f_t$$

$$s_t = f_t + \frac{\lambda \rho}{1+\lambda(1-\rho)} \Delta f_t$$

The Change in the Exchange Rate and its Variance

The first difference in the nominal exchange rate is stationary, and follows,

$$\Delta s_t = \frac{1+\lambda}{1+\lambda(1-\rho)}\Delta f_t - \frac{\lambda\rho}{1+\lambda(1-\rho)}\Delta f_{t-1}$$

After some algebra, one finds that,

$$Var(\Delta s_t) = \left(1+\frac{2(1-\rho)(1+\lambda)\lambda\rho}{\left(1+\lambda(1-\rho)\right)^2}\right)Var(\Delta f_t) > Var(\Delta f_t)$$

If the fundamentals follow an integrated AR(1) process then the monetary model can potentially explain the excess volatility of nominal exchange rates. However, it cannot explain fluctuations in the real exchange rate, nor can it account for the high positive correlation of fluctuations in nominal and real exchange rates.