How does a devaluation affect the current account?

M.B. Devereux*

Department of Economics, University of British Columbia, 997-1873 East Mall, Vancouver, British Columbia, Canada V6T 1Z1

Abstract

This paper explores how an exchange rate devaluation affects the current account in a sticky-price inter-temporal optimizing model. The main issue addressed is how the features of international pricing affect the response of the current account. When prices are all set in the producer’s currencies, the effect of a devaluation on the current account depends on the conventional Marshall–Lerner conditions. This is fundamentally an a-temporal condition (depending on the elasticity of substitution between home and foreign goods). However, when prices are all set in consumer’s currencies, the response of the current account depends upon the size of the inter-temporal elasticity of substitution of consumption across time periods. This represents an inter-temporal condition. When pricing-to-market is partial, the effect of devaluation on the current account depends on the strength of the a-temporal elasticity relative to the inter-temporal elasticity. © 2000 Elsevier Science Ltd. All rights reserved.

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1. Introduction

How does a devaluation affect the current account? This question has been extensively addressed in traditional open economy macroeconomics. In the Mundell–Fleming model a devaluation will improve the trade balance if the Marshall–Lerner conditions are fulfilled. This represents an a-temporal condition that depends upon the elasticities of demand for home and foreign goods.
For the last two decades, most of the current account literature has moved towards an inter-temporal choice theoretic approach (see Obstfeld and Rogoff, 1996, for a survey), stressing the importance of consumption smoothing and investment as an explanation for current account dynamics. This literature has the attractive feature that the reasoning is based on optimizing models, where preferences, technology, and capital market access is explicitly spelled out. Until recently, however, most of this literature has focused on non-monetary environments, or on environments with fully flexible nominal price levels. In such models, monetary neutrality holds, so that a devaluation is unlikely to have important effects. Therefore, the analysis of the current account impacts of a devaluation in inter-temporal settings is substantially limited within these models.

In the last few years, however, researchers have been developing inter-temporal optimizing sticky-price open economy macroeconomic models. The genesis of this literature is widely attributed to the paper by Obstfeld and Rogoff (1995) (henceforth OR). They analyze the impact of a monetary shock under floating exchange rates when prices are temporarily sticky. They show that a monetary expansion unambiguously improves the current account.

In this paper we take an extension of the OR model to allow for a different type of pricing structure. Instead of having prices set in the producer’s currency, as in the original OR model, we allow for the possibility that some firms in one or both countries might set prices in the currency of final sales. This type of pricing structure has been referred to as “short-run pricing-to-market” by Goldberg and Knetter (1997). The justification for focusing on this alternative type of pricing structure is that it is consistent with the recent findings of Engel (1993, 1999) and Engel and Rogers (1996), indicating substantial deviations from the law of one price in traded goods across countries, which are almost fully accounted for by movements in nominal exchange rates.

Within this fairly straightforward extension of the original OR model, we investigate the impact of a devaluation on the current account. Our results can be easily summarized. The impact of a devaluation on the current account can be determined either by a-temporal “elasticity” considerations, or by inter-temporal, “consumption smoothing”, considerations. Which effect dominates depends critically on the extent of pricing-to-market. When all export prices are set in producer’s currencies, the response of the current account to a devaluation is dominated by the “expenditure-switching” effects of the exchange rate change. The devaluation will improve the trade balance as long as the Marshall–Lerner conditions, as applied to this model, hold true. These conditions depend on the elasticity of substitution between home and foreign goods. Because in this case, PPP holds at all times, real interest rates are equated across countries, and capital markets equalize consumption growth across countries. This implies that the consumption-smoothing motive in consumer preferences has no role at all to play in the response of the current account to a devaluation.

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1 See Lane (1998b) for a comprehensive survey of the recent literature in this area.
The effects of a devaluation on the trade balance are analogous to those in the traditional textbook model.

On the other hand, when export pricing is dominated by pricing-to-market, the Marshall–Lerner conditions are irrelevant, since a devaluation does not alter actual goods’ prices facing consumers. In this case, the impact of a devaluation on the trade balance depends solely on the importance of the inter-temporal consumption-smoothing motive in consumer preferences. With pricing-to-market, real interest rates and consumption growth can differ across countries, due to deviations from purchasing power parity. The response of consumption to real interest rates is determined by the inter-temporal elasticity of substitution. It is shown that with extensive pricing-to-market, devaluation will improve, leave unchanged, or reduce the current account, as the elasticity of inter-temporal substitution is less than, equal to, or greater than unity. Thus, in the presence of full pricing-to-market, the impact of a devaluation on the current account is fundamentally determined by inter-temporal considerations.

In intermediate cases where there is partial pricing-to-market, the impact of a devaluation on the trade balance is determined by the relative strength of the a-temporal elasticity of substitution between commodities and the inter-temporal elasticity of substitution between consumption over time.

This paper is related to a number of other papers in the recent literature, besides OR. Betts and Devereux (2000) develop the basic model of pricing-to-market (for a simpler case than analyzed here) and examine its effects for exchange rate dynamics and international transmission. Lane (1998a) develops a small open economy two-sector model, and shows a condition that is somewhat similar to one of the conditions for the impact of a devaluation in our paper. We compare our paper more fully with that of Lane below. Other important contributions are those of Tille (1998a,b) and Lombardo (1998). Tille (1998a) examines the impact of monetary policy on domestic and foreign welfare under different assumptions regarding the elasticity of substitution between goods within a country and between composite goods across countries. He shows that a sufficient condition for the current account to improve in response to a monetary expansion is that the elasticity of substitution between composite goods across countries exceeds unity. Tille (1998b) extends the reasoning to an environment of pricing-to-market, but does not focus on the decomposition of current account effects. Finally, Lombardo (1998) also derives conditions allowing for a negative current account response to a monetary expansion when the elasticity of substitution within and across countries is allowed to be variable. The principal difference between the present paper and the three latter papers is that we stress the dominant role of the inter-temporal elasticity of substitution for the response of the current account when there is pricing-to-market.

Section 2 develops the basic model, which is just a simple extension of OR, extended to fixed exchange rates and pricing-to-market. Section 3 shows how to derive the impact of an unanticipated permanent devaluation. Section 4 explores the impact of a devaluation on the current account. Section 5 offers some conclusions.
2. A two-country model with fixed exchange rates

Our aim is to develop a simple two-country model which can be used to analyze the impact of devaluation on the trade balance. As discussed above, much recent research has adopted the framework developed by OR (1995). In this model, there is a continuum of differentiated goods of measure 1. A share \( n \) of the goods is produced by the home country, which also has population \( n \), and measure \((1-n)\) is produced by the foreign country, with population \((1-n)\). Foreign country variables are denoted with an asterisk.

We make the assumption that firms in each country are monopolistic sole producers of their goods, and in addition, following Betts and Devereux (2000) and Tille (1998b), that some fraction of firms can segment their markets between sales to their domestic consumers and foreign consumers. In the home country (foreign country), this fraction is \( s \) (\( s^* \)). Thus, in the home (foreign) country, \( s \) (\( s^* \)) firms can “price-to-market” (PTM).\(^2\) Clearly \( 0 \leq s \leq 1 \) and \( 0 \leq s^* \leq 1 \).

Preferences are assumed identical across countries. We make the following assumption about consumer preferences in the home country.

\[
U = \sum_{i=0}^{\infty} \beta^i \left[ \frac{C_i^{1-\omega}}{1-\omega} + \frac{1}{1-\omega} \left( \frac{M_i}{P_i} \right)^{1-\epsilon} + \eta \log(1-H_i) \right].
\]

Here \( C \) is consumption of a composite good, defined as

\[
C_i = \left( n \right)^{\frac{1}{\lambda}} C_h^{\frac{1}{\lambda}} + \left( 1-n \right)^{\frac{1}{\lambda}} C_f^{\frac{1}{\lambda}}, \quad \lambda > 0,
\]

where

\[
C_h = \left( n^\frac{1}{\rho} \right)^{\int_0^n} C_h(i, t)^{\frac{1}{\rho}} \, dt \left( \frac{1}{\rho} \right)^{\frac{1}{\rho}} \quad \text{and} \quad C_f = \left( n^\frac{1}{\rho} \right)^{\int_n^1} C_f(i, t)^{\frac{1}{\rho}} \, dt \left( \frac{1}{\rho} \right)^{\frac{1}{\rho}}, \quad \rho > 1.
\]

The consumption composite is in turn a function of consumption of the composite home good \( C_h \) and foreign good \( C_f \). The home and foreign goods are substitutable among one another with elasticity \( \lambda \). The home and foreign goods are themselves functions of individual home and foreign varieties, which have elasticity of substitution \( \rho \). In order for the profit maximization decision problem of firms to be well

\(^2\) Note that the interpretation of the term “pricing-to-market” is somewhat different than the literature on PTM by Krugman (1987), Dixit (1989), Froot and Klemperer (1989) and Marston (1990) and others. These papers take the exchange rate process as given exogenously, and investigate the factors by which firms would choose to adjust prices in foreign markets with less than full exchange rate “pass-through”. In our analysis, pricing-to-market refers to the practice of setting nominal prices in different currencies for domestic and foreign sales. In this case, an unexpected change in the exchange rate automatically generates a deviation from the law of one price. Goldberg and Knetter (1997) refer to this practice as “short-term pricing-to-market”. In the absence of nominal rigidities, however, this type of PTM would have no real effects whatsoever.
defined, it is necessary that $\rho > 1$. $M/P_t$ represents real balances, defined in terms of home currency. $H_t$ is hours worked by the representative home household.

The consumer price index (CPI) for the home country depends on the price of home goods and foreign goods in the following way.

$$P_t = (nP_{ht}^{1-\lambda} + (1-n)P_{ft}^{1-\lambda})^{\frac{1}{1-\lambda}}$$

where

$$P_{ht} = \left(\frac{1}{n} \int_0^n P_h(i, t)^{1-\rho} \, di\right)^{\frac{1}{1-\rho}}$$

and

$$P_{ft} = \left(\frac{1}{1-n} \int_{n^{s^*}}^{1-n} P_f(i, t)^{1-\rho} \, di + \frac{1}{1-n} \int_{n^{s^*}}^{1-n} \left(E_t P_f^*(i, t)^{1-\rho} \, di\right)\right)^{\frac{1}{1-\rho}}.$$

The CPI is explained as follows. Of the $n$ home firms, each of them sells to home consumers in prices denominated in home currency $P_h(i, t)$. Of the $(1-n)$ foreign firms, a fraction $s^*$ sell to the home market in prices $P_f^*(i, t)$ denominated in home currency. The rest of the foreign firms sell at prices denominated in foreign currency $P_f(i, t)$ and thus these prices must be multiplied by the exchange rate $E_t$ to convert to domestic currency.

Using a similar logic, the foreign CPI is defined as

$$P_t^* = (nP_{ht}^{1-\lambda} + (1-n)P_{ft}^{1-\lambda})^{\frac{1}{1-\lambda}},$$

where

$$P_{ht}^* = \left(\frac{1}{n} \int_0^{ns^*} P_h^*(i, t)^{1-\rho} \, di + \frac{1}{n} \int_{ns^*}^{1} \left(P_h(i, t)^{1-\rho} \, di\right)\right)^{\frac{1}{1-\rho}}$$

and

$$P_{ft}^* = \left(\frac{1}{1-n} \int_{n^{s^*}}^{1-n} P_f^*(i, t)^{1-\rho} \, di\right)^{\frac{1}{1-\rho}}.$$

Here, the foreign country CPI depends upon home goods whose prices are denominated in foreign currency ($P_h^*(i, t)$), and goods whose prices are denominated in home currency ($P_h(i, t)$). Note that the home CPI depends directly on the current exchange rate only insofar as the foreign firms do not all follow a pricing-to-market policy. Likewise the foreign CPI will depend on the exchange rate only if home firms do not all follow pricing-to-market.

Households in the home economy consume, supply labor at nominal wage $W_t$, and accumulate money and nominal domestic currency denominated bonds. They also receive profits from domestic firms, and a transfer from the government.

$$P_t C_t + M_t + d_t F_t + E_t d_t^* F_t^* = W_t H_t + \Pi_t + M_{t-1} + F_{t-1} + E_t F_{t-1}^* + TR_t.$$
Here \(d_t(d^*)\) represents the price of a home currency (foreign currency) nominal bond, \(F_t(F^*)\) is the current acquisition of home currency (foreign currency) bonds, \(\Pi_t\) is profits rebated by domestic firms, and \(\text{TR}_t\) is a transfer.

The problem facing foreign households is analogous. Firms in the home country produce output directly from labor. Firms set prices one period in advance. A firm that sets a unified world price for its good will set that price in domestic currency. It is assumed, however, that for a firm that can segment its markets and price-to-market, domestic prices are set in the home currency, but foreign prices in foreign currency. The logic of this assumption is based on the empirical evidence, cited in the introduction, that imported goods prices tend to be stable in terms of the currencies of local sale, and only weakly related to exchange rate changes. A theoretical justification for stability of local currency prices could be constructed based on the presence of menu costs of price change. A firm that sets its export price in terms of its domestic currency must constantly alter its foreign-currency sale price in the foreign market, in response to exchange rate changes. If there are menu costs of price changes at the retail level, then these price changes are costly. The firm could reduce these costs by pricing in local currency of sale, avoiding the necessity of changing prices as exchange rates change. This argument is developed somewhat more formally in Appendix B.

Because all goods are identical and the elasticity of demand facing firms is the same in each country, the desired markup of a monopolist firm over its marginal cost will be equal in both markets. Thus, if prices were flexible, or could be adjusted following a shock to the exchange rate, then a firm would in fact set identical prices in both markets. However, if there are unanticipated shocks to the exchange rate, deviations from the law of one price will occur for firms that engage in PTM.

Prices are set only for one period in advance, however. Once a permanent shock has occurred, prices will adjust after one period, so that there will be no deviations from the law of one price in the period following a permanent shock.

We assume that the government directly controls the exchange rate. As a result, the money supply will become endogenous. The government budget constraint is

\[M_t = M_{t-1} + \text{TR}_t.\]

Government issues money, donates transfers (domestic credit) to the private sector. It is assumed that the government’s domestic credit policy is adjusted in order to maintain a fixed exchange rate.³ Our analysis focuses on the effects of a permanent, unanticipated exchange rate depreciation. Note that following the devaluation, the exchange rate is also taken as pegged, but at a higher level.

³ We might also model the dynamics of government foreign reserves, but this is inessential for the analysis, since monetary policy can be designed to maintain any value of the exchange rate. Thus reserves are omitted, for simplicity.
3. The solution of the model

We solve the model under a fixed exchange rate regime. The home country adjusts its stream of domestic credit so as to maintain this peg, while the foreign country follows an arbitrary monetary policy. Thus, effectively, the world price level will be determined by monetary policy in the foreign country.

Let there be an unanticipated, permanent devaluation in period \( t \).\(^4\) This will have real effects because prices are sticky. However, prices can adjust after one period, so the world economy will have adjusted fully after that (due to the fact that preferences are identical, and there is no physical capital, so that in the absence of exogenous shocks, there are no dynamics in the model). Nevertheless, the devaluation may have permanent effects because it may affect the current account in period \( t \). To solve the model then we break down the solution into two parts. Starting at period \( t+1 \), we solve for the consumption and output levels of each economy, as a function of the initial value of external claims \( F_t \). Since the steady state is attained in period \( t+1 \), these solutions apply for all periods \( j \geq t+1 \). Then, moving back to period \( t \), we solve for consumption, output and the current account, using the period \( t+1 \) solution.

Assume a symmetric outcome where all home firms set the same prices, and similarly for foreign firms. In period \( t+1 \) the price index for the home country will then be

\[
P_{t+1} = (nP_h^{1-\lambda}) + (1-n)(EP_r^{*})^{(1-\lambda)})^{1/(1-\lambda)}.
\]

The foreign CPI will be

\[
P_r^{*} = \left( n \left( \frac{P_h}{E} \right)^{(1-\lambda)} + (1-n)P_r^{*(1-\lambda)} \right)^{1/(1-\lambda)}.
\]

Thus, PPP will clearly hold in periods \( t+1 \) and later.

Substitute the government budget constraint into the private sector budget constraint. Then in period \( t+1 \) the home country will face a budget constraint

\[
P_{t+1}C_{t+1} + d_{t+1}F_{t+1} = P_{h+1}F_{t+1} + F_r + E\tilde{F}_r.
\]

This equation is explained as follows. In period \( t+1 \), all domestic firms will set the same price, evaluated in home currency, because the exchange rate is known with certainty. Thus, the nominal value of domestic output is \( P_{h+1}F_{t+1} \), since output per capita is equal to per capita employment. In addition, the net foreign assets of the economy at the beginning of period \( t+1 \) are given by \( F_r + E\tilde{F}_r \), those accumulated at the end of period \( t \).

The domestic households’ labor supply decision, combined with the profit maxim-

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\(^4\) One could argue that the likelihood of devaluation would be an important element in private sector decision-making in goods and financial markets, and hence, an unanticipated devaluation is an impossibility. However, recent events in Asia, Russia and Latin America indicate that currency devaluation may take the market by surprise. More generally, there is a long tradition of analyzing unanticipated policy shocks in macroeconomics. The experiment we look at falls within this tradition.
izing markup of the home firms, can be described by the condition which trades off the value of leisure against the real wage

\[ \frac{\eta}{1-H_{t+1}} \frac{\rho-1}{\rho} P_{H_{t+1}} \frac{1}{C_{t+1}}. \]  

(2)

The foreign country has a similar pair of conditions to Eqs. (1) and (2). Since there are no current account dynamics beyond period t+1, it must be that \( F_{t+1} + E\bar{F}_{t+1} = F_t + E\bar{F}_t \). Moreover, the nominal discount factor will be identical across countries and equal to \( \beta \). We may then represent the period t+1 (and later) equilibrium by the following conditions.

\[ \bar{C} = \frac{\bar{P}_h}{\bar{P}} \bar{H} + (1-\beta)A \]  

(3)

\[ \bar{C} = \frac{\bar{P}_h}{\bar{P}} \bar{H} - (1-\beta)(1-n) \frac{A}{\bar{P}}. \]  

(4)

\[ \frac{\eta}{1-H} \frac{\lambda-1}{\lambda} \frac{\bar{P}_h}{\bar{P}} \bar{C}^{\omega}. \]  

(5)

\[ \frac{\eta}{1-H^*} \frac{\lambda-1}{\lambda} \frac{\bar{P}_h}{\bar{P}^*} \bar{C}^{\omega}. \]  

(6)

\[ \bar{H} = \left( \frac{\bar{P}_h}{\bar{P}} \right)^{-\rho} (n\bar{C} + (1-n)\bar{C}^*). \]  

(7)

Since all variables are constant from time t+1 onwards, we denote these with a tilda. Eqs. (3) and (4) represent the home and foreign country balance of payments conditions, with the international bond market clearing condition \( nA + (1-n)A^* = 0 \) incorporated, where \( A = F + E\bar{F} \) represents the net foreign asset position of the home country. Eqs. (5) and (6) represent labor market equilibrium in the steady state. Finally Eq. (7) represents the goods market clearing condition for the representative home commodity. Eqs. (3)–(7) can be solved for \( \bar{C}, \bar{C}^*, \bar{H}, \bar{H}^* \), and \( \bar{P}_h \), i.e. the terms of trade for the home country, conditional on \( A \). In turn, \( A \) is determined by the period t current account.

In addition, we need a condition to pin down the world price level in period t+1 and onwards. This is given by foreign-country money market clearing, which is

\[ \frac{\bar{M}^*}{\bar{P}^*} = \left( \frac{\bar{C}^{\omega}}{\bar{P}^{\omega}} \right)^{\frac{1}{\rho}} \left( \frac{1-\beta}{\bar{P}^*} \right). \]  

(8)

This determines \( \bar{P}^* \).

In period t, the time of the devaluation, we may describe the equilibrium by the following conditions.
\[
\frac{M^*}{P^*} = \left( \frac{C_{t^*}}{1 - d_t} \right)^{\frac{1}{\kappa}}, \quad (9)
\]

\[
P_t^s + d_t A_t = (1 - s)P_{ht}Y_t + s(P_{ht}X_t + \bar{EP}_tZ_t), \quad (10)
\]

\[
Y_t = \left( \frac{P_{ht}}{P_t} \right)^{\frac{\lambda}{\lambda}} nC_t^* + \left( \frac{P_{ht}}{\bar{EP}_t^s} \right)^{\frac{\lambda}{\lambda}} (1 - n)C_t^s, \quad (11)
\]

\[
X_t = \left( \frac{P_{ht}}{P_t} \right)^{\frac{\lambda}{\lambda}} nC_t, \quad (12)
\]

\[
Z_t = \left( \frac{P_{ht}}{P_t^s} \right)^{\frac{\lambda}{\lambda}} (1 - n)C_t^s, \quad (13)
\]

\[
d_t = \beta P_t^s C_t^s \omega \quad (14)
\]

\[
d_t = \beta \frac{E_t^s P_t^s C_t^s \omega}{E_t^s C_t^{* \omega}} \quad (15)
\]

Eq. (9) is the foreign money market equilibrium condition. The second equation is the home period \( t \) balance of payments condition. The home country receives income from the non-PTM firms, who sell at a common price to both home and foreign consumers. This explains the first term on the right hand side of Eq. (10). However, income is also received from PTM firms, who sell at potentially separate prices to home and foreign consumers. Hence \( Y_t \) is the demand for a non-PTM firm, \( X_t \) is the home demand for a PTM firm, and \( Z_t \) is the foreign demand for a PTM firm. Eqs. (14) and (15) represent the inter-temporal Euler equation for the home and foreign consumer. Conditional on time \( t+1 \) variables, Eqs. (9)–(15) determine the seven variables, \( C_t, C_t^*, A_t, d_t, Y_t, X_t, \) and \( Z_t \).

4. The effects of a devaluation on the current account

Now let us examine the impact of an unanticipated devaluation in period \( t \) on the current account of the home country. Although the model is quite simple, there is still no easy analytical solution available. We solve the model by a linear approximation around an initial symmetric steady state, with \( A_t = 0 \). Thus, in the initial equilibrium, all home and foreign variables are identical. For any variable \( U \), let the small case letter denote proportionate deviations from the initial steady state. Hence \( u = (U - \bar{U})/\bar{U} \) where \( \bar{U} \) is the initial steady state value. The derivation is greatly simplified by focusing on the impact of the devaluation on the two variables and \( c_t - c_t^* \), \( dA_t \) (since \( A_t \) begins at zero, it must be written in difference form rather than proportionate deviations).

Note first that if we differentiate the price indices around the symmetric initial equilibrium we obtain
If \( s = s^* = 0 \), then the law of one price is maintained continually, and PPP holds. However, if either \( s \) or \( s^* \) is positive, then PPP is violated by an unanticipated devaluation. The impact of the devaluation on the real exchange rate depends upon both relative country size and the degree of PTM in each country.\(^5\)

From the five Eqs. (3)–(7), we may derive the impact of a rise in \( A_t \) on the future consumption differential. This is given by

\[
\bar{c}_t - \bar{c}_t^* = \gamma \frac{\beta}{\sigma (1-n)} \frac{dA_t}{PC^{\text{W}}}. \tag{17}
\]

Here the variable \( r = (1-\beta)/\beta \) is the steady state equilibrium real interest rate, and \( \sigma \) is defined as

\[
\sigma = \left( \frac{1+\chi(1-\omega)+\chi\omega}{1+\chi/\lambda} \right),
\]

where \( \chi \) is the consumption-constant elasticity of labor supply. We would anticipate that \( \sigma > 0 \). It is possible however, that \( \sigma < 0 \) if \( \omega > 1 \) and \( \lambda \) is sufficiently below unity. However, from Eq. (17) this requires that there is a form of immiserizing growth — home country consumption is reduced by a rise in home wealth. We rule out this case as uninteresting for our analysis.

Therefore, Eq. (17) says that a permanent rise in net foreign assets will increase the ratio of home to foreign consumption. The amount by which the consumption ratio rises depends on the elasticity of labor supply. For \( \chi = 0 \) the consumption ratio rises by (approximately) the interest rate times the increase in home assets, relative to the foreign population. However, if \( \chi > 0 \), the consumption ratio increases by less, because the higher home country (lower foreign country) consumption will reduce (increase) home (foreign) labor supply, thus mitigating the impact on consumption.

Consumption between period \( t \) and the future is linked by equations Eqs. (14) and (15). Using the properties of the price indices, we can use these equations to show that

\[
\bar{c}_t - \bar{c}_t^* = c_t - c_t^* = \frac{1}{\omega} (sn + s^*(1-n)) e. \tag{18}
\]

\(^5\) Take for instance the case where \( S^* = 1 \), but \( s = 0 \), indicating that the foreign country sets all its export prices in home currency, but the home country sets all its export prices in its own currency. In addition, assume that \( n \) is close to unity, so the home country is very large. Then the real exchange rate is affected only slightly by a devaluation. The absence of pass-through of exchange rates into the home CPI has quite a minor effect, because the share of foreign goods in home consumption is low, while on the other hand, the full pass-through of the exchange rate to the foreign CPI tends to almost completely offset the direct effects of the devaluation on the real exchange rate.
The presence of PTM in period $t$ leads to departures from PPP, and therefore deviations from real interest rate parity across countries. When either $s$ or $s^*$ is positive, then a nominal depreciation is not fully offset by CPI movements, so there is a real depreciation of the home currency. However, the future real exchange rate is constant; PPP holds in the future. Thus the temporary real depreciation leads to a temporary fall in the home real interest rate and therefore a fall in the growth rate of home relative to foreign consumption.

From the balance of payments Eqs. (10)–(13) we can derive the following relationship between period $t$ relative consumption, asset accumulation, and the exchange rate devaluation.

$$\beta \frac{dA_t}{PC_t} = (1-n)((\lambda-1)(1-s(1-n)-s^*n)+(1-n)s^*+sn)e_r - (c_t-c_t^*)).$$

(19)

In response to an unanticipated devaluation, the home country will experience a current account surplus if the effect impact on home relative to foreign income exceeds the impact on home relative to foreign consumption. The effect of the devaluation on income depends upon the degree of pricing-to-market. When $s=s^*=0$, the devaluation raises the price of foreign goods and reduces the price of home goods, for consumers of both countries. If $\lambda>1$, this would lead world spending to switch towards the home country, raising home country relative income. On the other hand, if $s=s^*=1$, the devaluation has no effect on relative prices facing consumers. Yet it increases relative home income directly by increasing the export revenue of home firms, which are priced in foreign currency, and reducing the revenue of foreign firms from exports to home, which are priced in home currency.

In general, both channels will be working to affect current relative income. If pricing-to-market is asymmetric across countries, for instance if $s^*=1$, but $s=0$, then a devaluation will have expenditure-switching effects because it will reduce the price of home goods for foreign consumers, but have no affect on prices facing home consumers. However then it will also have revenue effects for foreign firms, as their foreign currency revenues will fall.

Now put Eqs. (17)–(19) together to derive the effect of a devaluation on the home country current account.

$$\beta \frac{dA_t}{PC_t} = \frac{\sigma}{\sigma+r}(1-n)((\lambda-1)(1-s(1-n)-s^*n)+(1-n)s^*+sn)e_r.$$  

(20)

The impact on relative consumption at time period $t$ is

$$c_t-c_t^* = \frac{r}{\sigma+r}((\lambda-1)(1-s(1-n)-s^*n)e_r + [(1-n)s^*+sn]e_r.$$  

(21)

How will a devaluation affect the current account? Eq. (20) indicates that the answer is not immediate, but depends, in quite an involved way, on the elasticity of labor supply, country size, pricing policies in both countries, and the elasticity of inter-temporal substitution.
Take the easiest case to start with. Say that \( s = s^* = 0 \). Then a devaluation will improve the current account so long as the intra-temporal elasticity of substitution between home and foreign goods exceeds one; i.e. \( \lambda > 1 \). This result is the same as that of Tille (1998b).\(^6\) In this case, the impact on the current account is consistent with traditional models. When \( \lambda > 1 \) the devaluation raises relative real income through the reallocation of world spending towards the home country. The rise in relative income is temporary, however, so in order to achieve consumption smoothing, relative consumption rises only by a fraction \( \frac{r}{\sigma + r} \) of the increase in relative income. Hence the current account will improve. The increase in the current account is larger, the lower is the world interest rate, and the greater is the elasticity of labor supply. In the first case, a lower interest rate implies a lower subjective discount rate, and for a given increase in current relative income, the response of relative consumption is less. In the second case, the higher the value of \( \sigma \), the less will be the impact of a given increase in \( A_t \) on future relative consumption, due to the endogenous movement in labor supply. As a consequence, current relative consumption will rise by less, and the current account improves by more. On the other hand, when \( \lambda < 1 \), a devaluation shifts world spending away from home country goods, and the current account falls.

Note that in the case where \( s = s^* = 0 \), the impact of a devaluation on the current account is driven by a-temporal considerations. In particular, the inter-temporal elasticity of substitution \( 1/\omega \) has no implications for the response of the current account. The condition that the current account will improve is just that \( \lambda > 1 \). However, this is simply a version of the standard “Marshall–Lerner” condition in this model. With sticky prices, from Eq. (11) we can establish that the elasticity of demand for the home good is \( \lambda(1 - n) \). Likewise, the elasticity of demand for the foreign good is \( \lambda n \). As long as their sum exceeds unity, the trade balance improves.\(^7\)

Now take the polar opposite case, where \( s = s^* = 1 \). Then the impact of a devaluation on the current account depends upon the magnitude of the inter-temporal elasticity of substitution coefficient \( 1/\omega \). When this elasticity is unity, the current account is unaffected by a devaluation. When the elasticity is greater than (less than) unity, a devaluation deteriorates (improves) the current account.

The intuition behind the current account response when \( s = s^* = 1 \) can be explained as follows. With prices fixed in local currencies, there is no impact of a devaluation on relative goods prices facing consumers. Therefore, there is no reallocation of world expenditure towards home country goods. As shown in Appendix A, output rises by an equal amount in the home and foreign country. However, the devaluation...

\(^6\) In the OR case, the elasticity of substitution between all goods varieties is the same as that between home and foreign goods. For an interior solution to the firm’s profit maximization problem, it is then necessary that \( \lambda > 1 \).

\(^7\) In principle, it is possible for the current account to improve even if \( \lambda < 1 \), if \( \sigma < 0 \). This is shown in Lombardo (1998). However in our model, this requires immizerizing growth, as shown in Eq. (17). We thus ignore this case. See the discussion in Tille (1998a).
causes an increase in the relative price of home country goods. So while output responds by an equal amount in both countries, real income rises in the home country, relative to the foreign country. This by itself would tend to generate a current account improvement for the home country, in the same way as the previous case. But there is another effect, arising from the fact that real interest rates are not equated across countries. The temporary real depreciation causes a fall in the home country real interest rate. This induces a further rise in home country consumption. When \( \omega = 1 \), the combination of a rise in real income and fall in the real interest rate leads consumption to rise by exactly the same amount as the rise in real income, and the current account is unchanged. Then, as Appendix A shows, there is no international transmission of a devaluation on foreign consumption or real income.

However when \( \omega > 1 \), the inter-temporal elasticity of substitution is less than unity, current consumption is less responsive to a fall in the real interest rate, and consumption increases by less than the increase in income. In that case, the current account improves. Finally, when \( \omega < 1 \), consumption is more responsive to a fall in the real interest rate, consumption rises by more than the increase in real income, and the current account deteriorates.

Therefore, with full PTM, the impact of a devaluation on the current account is determined solely by the importance of inter-temporal consumption smoothing. The current account will improve only if consumers have a relatively high preference for consumption smoothing.

We may conclude, therefore, that whether a-temporal Marshall–Lerner considerations or inter-temporal consumption-smoothing considerations dominate the current account effects of a devaluation depends primarily on the importance of pricing-to-market in international commodity markets.

These two cases illustrate a very different mechanism for a devaluation to affect the current account. To see the difference more clearly, we use the following expression for the home country current account at time \( t \) (this can easily be derived from a combination of period \( t \) and \( t+1 \) budget constraints)

\[
\frac{dA_t}{PC^w(1-n)} = \left[ (y_t - \tilde{y}) - (y^* - \tilde{y}^*) \right] - \left[ (c_t - \tilde{c}) - (c^* - \tilde{c}^*) \right].
\] (22)

Here \( y_t \) represents home country real income at time \( t \) (the right hand side of Eq. (10) divided by the CPI), and \( y^*_t \) is foreign real income. When \( s = s^* = 0 \), the current account improves when \( \lambda > 1 \), because in this case current home real income rises relative to foreign real income, future home real income falls relative to foreign real income, while the growth rates of consumption are equalized. Thus, the first expression on the right hand side of Eq. (22) is positive, while the second expression

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8 Since export prices are fixed in the foreign currency, and import prices are fixed in the home currency, a devaluation must raise the home currency relative price of home goods in terms of foreign goods.

9 Note that when \( \lambda = 1 \), and \( s = s^* = 0 \), so that \( y_t - \tilde{y}_t = 0 \), it will still be the case that output of the home country rises relative to output of the foreign country, due to the relative price effects of the exchange rate. The argument here pertains not to output differentials, but real differentials.
is zero. The response of the current account depends only on the current and future movement in income, and is independent of the degree of consumption smoothing in preferences.

However, when $s = s^*=1$, the degree of consumption smoothing is the central determinant of the current account. The first expression in Eq. (22) is still positive. Home country current real income rises relative to foreign real income. But the second expression is also positive, by Eq. (18), as home consumption growth falls below foreign consumption growth. In this case the impact of the devaluation on the current account is dictated primarily by the elasticity of inter-temporal substitution.

Between the two extremes of zero and full pricing-to-market there is a wide variety of current account possibilities following a devaluation. If both $s$ and $s^*$ lie between zero and unity, then the current account is affected by both the a-temporal, expenditure-switching effects of devaluation, as well as the inter-temporal interest rate effects. A particularly interesting case is where one country follows full pricing-to-market, while the other country prices in its own currency. This might be characteristic of a large country, which sets all traded goods prices in its own currency, trading with a small country, which sets export prices in the currency of its trading partner. Let $s=0$ and $s^*=1$. Then the current account effect of a devaluation is

$$
\beta \frac{dA_t}{PC^w} = \sigma \frac{\sigma + \nu}{\nu} (1-n) (\omega \lambda - 1) \omega e_t. \quad (23)
$$

Expression Eq. (23) says that the impact of a devaluation on the current account depends on the relationship between the intra-temporal elasticity of substitution between goods, $\lambda$, and the inter-temporal elasticity of substitution across time $\frac{1}{\omega}$.

When $\lambda > \frac{1}{\omega}$, the intratemporal effects of expenditure-switching dominate, and the current account improves. However, when $\lambda < \frac{1}{\omega}$, the inter-temporal effects of the fall in the real interest rate on current consumption dominate, and the current account deteriorates.\(^{10}\)

Condition Eq. (17) may be used to derive the relationship between $s$ and $s^*$ under which the current account response to a devaluation is zero. This is given by the equation

\(^{10}\) An identical condition for the impact of a monetary expansion on the current account is obtained by Lane (1998a) for a small open economy model with traded and non-traded goods. A similar logic underlies his model. When the elasticity of substitution between traded and non-traded goods is higher than the inter-temporal elasticity of substitution, the effect of a rise in the price of traded goods following a monetary expansion (and depreciation) dominates the effect of a fall in the real interest rate. It is interesting that our results are similar to Lane’s only in the case of asymmetric PTM.
In order for the current account response to be zero, it must be that either $\lambda > 1$ and $\omega < 1$, or $\lambda < 1$ and $\omega > 1$. Using this fact, we may illustrate condition Eq. (24) as the locus in Fig. 1. A higher value of $s^*$ entails a lower value of $s$ required to maintain a current account response equal to zero. Fig. 1(a) corresponds to the case of $\lambda > 1$ and $\omega < 1$. Above the locus, the current account deteriorates, while below the locus, the current account improves. Fig. 1(b) corresponds to the opposite case; i.e. $\lambda < 1$ and $\omega > 1$. In that case, points above the locus imply a current account improvement, while points below imply a current account deterioration. In each case, $n=0.5$. 

Fig. 1. (a) $\lambda > 1$, $\omega < 1$, (b) $\lambda < 1$, $\omega > 1$. 

\begin{equation}
 s = \frac{\lambda - 1}{\lambda (1-n)^{1-n-1}} - \frac{s^*}{\omega} \left[ \frac{1-\lambda n-(1-n)\frac{1}{\omega}}{1-\lambda (1-n)\frac{1}{\omega}} \right] 
\end{equation}
5. Conclusions

This paper has shown that in a sticky-price, inter-temporal optimizing model, the impact of a devaluation on the current account depends primarily on the degree of pricing-to-market. With prices fixed in producers’ currencies, the effect of a devaluation on the current account depends only on the Marshall–Lerner conditions, which may or may not hold in this model. When prices are set in consumers’ currencies (PTM), the impact of a devaluation on the current account depends on the inter-temporal elasticity of substitution. In this case, a devaluation may improve, deteriorate, or leave unchanged the current account, depending on the size of the elasticity. With full PTM, therefore, there is no presumption that a devaluation will improve a country’s current account.

The paper suggests that in conducting empirical analysis of the impacts of devaluation on the current account, it is important to study the features of international pricing.

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Appendix A. Derivation of results of Section 4

From the foreign country money market equilibrium, we may derive, in terms of proportional deviations from the initial steady state, the following relationship between the exchange rate, current and future consumption

\[
\left(1 + \frac{1}{\varepsilon r}\right)n(1-s)e_i = \frac{1}{\varepsilon} \left( \frac{\omega + 1}{r} \right) c_i^* - \frac{1}{\varepsilon r} (\rho^* + \bar{c}^*).\]

Give the second period money market equilibrium condition, this can be written as

\[
\left(1 + \frac{1}{\varepsilon r}\right)n(1-s)e_i = \frac{1}{\varepsilon} \left( \frac{\omega + 1}{r} \right) c_i^* - \frac{1}{\varepsilon r} \bar{c}^* \left(1 - \frac{\omega}{\varepsilon}\right). \quad (A1)
\]

In period \(t+1\) and onwards, there is no effect on world consumption (as current account movements from period \(t\) have consumption and output effects that exactly offset themselves across countries). Then, using Eq. (17) of the text, we may write

\[
\bar{c}^* = \bar{c}_W^n - n(\bar{c} - \bar{c}^*) = -n \frac{r}{\sigma + r} \left[ (\rho - 1)(1 - s)(1 - n) - s^*n \right] + \frac{(\omega - 1)}{\omega} \left[ (1 - n)s^* + sn \right] e_i. \quad (A2)
\]
Substituting Eq. (A2) into Eq. (A1) gives us
\[
c^* = \frac{\varepsilon r}{(1+r)} \left[ \frac{1}{\varepsilon r} n(1-s) - \frac{1}{\varepsilon r} \left( 1 - \frac{\omega}{\varepsilon} \right) n - \frac{r}{\sigma + r} \left( \rho - 1 \right) (1-s(1-n)\omega) \right] (A3)
\]
\[+ \frac{(\omega-1)}{\omega} \left( (1-n)s^* + n \right) \varepsilon_i. \]

From Eq. (A3), we may establish that when \( s=s^*=1 \) and \( \omega=1 \) there is no effect of devaluation on foreign consumption.

The time \( t \) level of output in the home economy is determined by the condition that
\[ H_t = (1-s)Y_t + s(X_t + Z_t). \]

where \( Y_t, X_t \) and \( Z_t \) are defined in the text. Differentiating this, we can establish that home output responds to a devaluation as
\[ h_t = c_t^W + \rho(1-n)(1-s(1-n)-s\varepsilon_i). \] (A4)

Likewise, foreign output satisfies
\[ h^*_t = c^*_t - \rho n(1-s(1-n)-s\varepsilon_i). \] (A5)

Eqs. (A4) and (A5) establish the claim in the text that output responses to a devaluation are equal across countries when \( s=s^*=1 \).

Note that home consumption satisfies
\[ c_t = c_t^W + (1-n)(c_t - c^*_t) = c_t^W + (1-n) \] (A6)

\[ \left[ \frac{r}{\sigma + r} (\lambda - 1) + (1-s(1-n)-s\varepsilon_i) + \frac{\sigma + r}{\sigma + r} \left( (1-s(1-n)\omega) \right) \right] \varepsilon_i. \]

Real income for the home country in the case of full PTM is \( (P_t X_t + EP_t Z_t)/P_t \). The proportional change in real income is just \( h_t + (1-n)\varepsilon_i \), i.e. the change in output plus the change in the terms of trade, adjusted for the share of exports in output. It is easy to see, using Eqs. (A5) and (A6) that when \( s=s^*=1 \), the difference between real income and consumption is
\[ h_t + (1-n)\varepsilon_i - c_t = (1-n) \left( \frac{\omega-1}{\omega} \right) \frac{\sigma}{\sigma + r} \varepsilon_i. \] (A7)
which is equivalent to Eq. (20) of the text. This establishes the heuristic argument given regarding the effects of devaluation on the trade balance under full PTM.
Appendix B. Incentives for a firm to price in foreign currency

We derive conditions under which it will be optimal for a firm to set its price for sale of goods in the foreign market in foreign currency terms rather than domestic currency. Take a simple partial equilibrium model of a firm that sells its good in a foreign market. Assume that the firm has profit function $\Pi^1(p^h, E)$ when setting its price in domestic currency, and profit function $\Pi^2(p^f, E)$ when setting its price in foreign currency, where $E$ is the exchange rate, $p^h$ is the home currency price of the good sold in the foreign market, and $p^f$ is the foreign currency price of the good sold in the foreign market. We denote these two alternatives as “pricing policy 1” and “pricing policy 2”, respectively.

Imagine that the firm were to choose its price ex-post, in response to exchange rate changes. Then we denote the optimal price as $\tilde{p}^h$ and $\tilde{p}^f$, and the maximum profit functions as $\Pi^1(\tilde{p}^h, E)$ and $\Pi^2(\tilde{p}^f, E)$. Moreover, because prices are being chosen ex-post, it must be that

$$\Pi^1(\tilde{p}^h, E) = \Pi^2(\tilde{p}^f, E),$$

(B1)
since, when prices are perfectly flexible, the currency of pricing cannot affect optimal profits. Moreover, it is obvious that

$$\Pi^1(\tilde{p}^h, E) \geq \Pi^1(p^h, E),$$

(B2)

$$\Pi^2(\tilde{p}^f, E) \geq \Pi^2(p^f, E).$$

(B3)

Assume that each time the firm adjusts the price facing foreign consumers, it incurs a fixed menu cost $Z$. If it follows pricing policy 1, it must alter its foreign price whenever the exchange rate changes. Thus, even if $p^h$ is not adjusted, the firm that sets its price in domestic currency will face net profits given by

$$\Pi^1(p^h, E) - Z$$

(B4)
when the exchange rate changes.

Now take the firm that is following pricing policy 2, and let the exchange rate change. Assume, however, that exchange rate changes are such that the firm would not wish to alter its price, given the menu cost. This requires that

$$\Pi^2(\tilde{p}^f, E) - \Pi^2(p^f, E) < Z.$$  

(B5)
Rearranging Eq. (B5), and using Eq. (B1), it follows that

$$\Pi^2(p^f, E) > \Pi^2(\tilde{p}^f, E) - Z = \Pi^1(\tilde{p}^h, E) - Z = \Pi^1(p^h, E) - Z.$$  

(B6)

The last inequality follows from Eq. (B2). However, the expression on the right hand side of Eq. (B6) is just equal to net profits under the pricing policy 1. Thus, if menu costs are such that the firm would not wish to alter its price using pricing policy 2, then profits under pricing policy 2 must exceed those under pricing policy 1. Thus, the implication of this is that when price stickiness is accounted for by
menu costs of price changing at the retail level, a firm that can segment its market will most likely find it desirable to fix its price for foreign markets in terms of foreign currency.

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