Pricing-to-Market and Exchange Rate Dynamics: A Primer

Carlo Frenquelli*
Università degli Studi di Macerata

This paper provides a graphical exposition for understanding Pricing-to-Market (PTM) from both the micro and macroeconomic points of view. In particular, the paper focuses on the microeconomic conditions necessary for firms to apply PTM, and on how monetary policy transmission mechanisms change when the economy is characterized by PTM, with special attention to its impact on exchange rates and other real variables. Finally, the paper attempts to determine whether, in presence of PTM, monetary policy is a beggar-thy-neighbor or prosper-thy-neighbor instrument. [JEL Classification: D21, D42, E52, F41, F42]

1. - Introduction

Every day we are repeatedly informed — by newspapers, television and the Internet — of the going rate of exchange between the dollar and the euro. Why is this information so important as to be continuously monitored? The answer is simple: more and more frequently, people can buy products made in any part of the world and denominated in any currency. Exchange rate changes can affect the price of goods simply by changing the cost of the currency the prices are expressed in. But do exchange-rate changes always affect the price of goods?

Answering that question is the first aim of this paper. In order

* <carlofrenquelli@yahoo.it>. The Author is grateful to Prof. Luca De Benedictis for his constant support and the invaluable suggestions offered in the many discussions during the preparation of this paper. He would also like to thank the anonymous referees of the Rivista di Politica Economica for their careful reading and useful observations. All the opinions expressed in this paper, and of course any errors, are attributable to the Author.
to remain competitive, many firms that operate on international markets follow price policies designed to keep their export prices competitive, regardless of exchange rate variations. To that end, their pricing strategy — applied simultaneously on different markets — is characterized by third-degree price discrimination policies based on markup adjustments determined by exchange rate changes: what Paul Krugman (1987) has called pricing-to-market (PTM). By applying pricing-to-market behaviour, firms implement *local currency pricing stability* (LCPS) strategies, meaning that they set — and maintain constant — the price of their exports in the currency of the destination markets. As we shall see, this can lead to incomplete exchange rate pass-through, or changes in import prices that are less than proportional to exchange rate fluctuations.

In recent years, concepts such as PTM, pass-through and LCPS have been studied by economists not only as regards the “theory of industrial organization” but also in connection with international macroeconomics\(^1\). The absence of complete pass-through can alter the transmission mechanisms of monetary and fiscal policies, thereby producing appreciable effects on macroeconomic variables such as consumption, output and the current account, as well as on exchange rate volatility itself.

During the last ten years a new current has developed in literature which tries to solve open macroeconomic problems by applying general dynamic equilibrium models based on explicit microfoundations, nominal rigidities and imperfect competition: the *New Open Economy Macroeconomics*\(^2\). The start of this line of thought is usually made to coincide with the publication of the paper entitled *Exchange Rate Dynamic Redux*, by Obstfeld and Rogoff (1995). The model presented by Obstfeld and Rogoff is the

\(^1\) As yet, this change of perspective has had little effect on economic policies, and policymakers continue to follow the principles of classical macroeconomics, even though these principles have shown their limits in explaining phenomena of no little account, including, for example, the limited effects of dollar-depreciation policies in reducing the United States’ trade deficit.

\(^2\) See Lane P.R. (2001) for an overview of the literature dedicated to the *New Open Economy Macroeconomics* and www.geocities.com/briarm_doyle/open.html for an updated list of articles in this area of research.
basic model of the new macroeconomics; it has been followed by many other studies bringing their own contributions to the theory. In particular, Betts and Devereux (1996 and 2000) and Otani (2002) extend the Redux Model in order to explore the macroeconomic implications of PTM.

The second aim of this paper is precisely to find out — by studying these models — if and how traditional macroeconomic theories (which do not contemplate PTM) change in the presence of incomplete exchange rate pass-through caused by pricing-to-market and local currency pricing stability. We will focus in particular on how monetary policy transmission mechanisms change when the economy is characterized by PTM, and how the exchange rate and other real variables respond when the economy suffers a monetary shock. Special attention will also be given to the ‘external’ effects of monetary policies. Basically, we will try to understand whether, in welfare terms, monetary policy is a beggar-thy-neighbor or a prosper-thy-neighbor instrument, or, in other words, whether monetary expansion produces, respectively, negative or positive effects on trading partner countries.

This paper is therefore a review of the chief aspects of pricing-to-market. The original contribution that we wish to introduce consists in going beyond the solution of complex mathematical models and suggesting analytical tools that are simpler and more intuitive. The important feature of this paper is the method applied for representing phenomena that are sometimes very complicated: the chosen approach allows a graphical exposition of the main implications of PTM.

The rest of this paper is structured as follows. In Section 2 a microeconomic analysis of pricing-to-market is presented: we will examine PTM behaviour taking the exchange rate as an exogenous variable. We will discuss what conditions are necessary for firms to apply price discrimination and how firms behave when the economy is hit by exchange rate shocks. In Section 3 PTM is examined from a macroeconomic perspective. The exogenous variable will be PTM, and the exchange rate will be assumed as the main endogenous variable. Section 4 presents our conclusions.
2. - Microeconomic Analysis of PTM

2.1 Exchange Rate Pass-Through

Exchange rate pass-through (ERPT) measures the extent to which exchange rate changes transfer to import prices denominated in the local market currency; ERPT is the percentage of change in local-currency import prices resulting from a 1% variation in the exchange rate between an importing country and an exporting country. Colombo and Lossani (2002) extend the equation that describes the law of one price to all imported goods, in terms of rate-change percentages:

\[
\frac{\dot{P}_{IM}}{P_{IM}} = \frac{\dot{E}}{E} + \frac{\dot{P}_{IM}^*}{P_{IM}^*}
\]

Changes in the local-currency prices of imported goods depend on changes in the exchange rate and in the foreign-currency price of the goods. Foreign producers determine their prices on the basis of unit production costs increased by unit profit margins \( k^* \) (markups), as exemplified by the following equation:

\[
P_{IM}^* = \frac{w^*}{A^*}(1 + k^*)
\]

where \( w^* \) and \( A^* \) represent, respectively, the foreign economy’s wages and its output level. Equations (1) and (2) can be combined to give:

\[
\frac{\dot{P}_{IM}}{P_{IM}} = \frac{\dot{E}}{E} + \left[ \frac{\dot{w}^*}{w^*} - \frac{\dot{A}^*}{A^*} + \frac{\dot{k}^*}{k^*} \right]
\]

Assuming, for simplicity, that foreign wages and output are constant (\( \dot{w}^* = \dot{A}^* = 0 \)), equation (3) can be reduced to:
where only two elements are taken into account: the percentage change rate of the nominal exchange rate and of the foreign producers’ markup.

We can now define $\gamma$, the pass-through coefficient, as a measure of the changes in import prices expressed in the local currency (the foreign consumer’s currency), following changes in the rate of exchange. In analytical terms:

\begin{equation}
\frac{\dot{P}_{IM}}{P_{IM}} = \frac{\dot{E}}{E} + \frac{\dot{k}^*}{k^*}
\end{equation}

(4)

We can now examine the behaviour of local-currency import prices and markups in three alternative scenarios:

1. **Import prices set in the producer’s currency and maintained constant**: $\dot{P}_{IM}^p/P_{IM}^p = 0$.

   Exchange rate changes are reflected by proportional changes in local currency import prices: $\dot{P}_{IM}/P_{IM} = \dot{E}/E$. In this case, $\gamma = 1$, pass-through is complete and the situation is as described in Alfred Marshall and Abba Lerner’s elasticity approach: the devaluation of local currency translates into higher costs of imported goods for local buyers.

2. **Import prices set in the consumer’s currency and maintained constant**: $\dot{P}_{IM}/P_{IM} = 0$.

   The invariance of local-currency import prices implies a percentage reduction in foreign-currency prices that is equal to the depreciation of the exchange rate. Since we are assuming that unit costs remain constant, this situation can be achieved only by reducing markups, which requires that:
In case there is no pass-through at all, \( \gamma = 0 \).

3. Consumer-currency import price changes are less than proportional to exchange rate changes: \( 0 < \left( \frac{\dot{P}_{IM}}{P_{IM}} \right) < 1 \).

Exchange rate changes have a limited effect on markups and on prices expressed in the producer's currency, \( \frac{\dot{P}^*_M}{P^*_M} = \frac{\dot{k}^*}{k^*} = -(1 - \gamma)\dot{E}/E \), and changes in local-currency import prices are less than proportional: \( \frac{\dot{P}_{IM}}{P_{IM}} = \gamma \dot{E}/E \).

In this case pass-through is incomplete\(^3\), \( \gamma < 1 \).

When pass-through is incomplete or zero, the residual impact of the adjustment falls on the unit profit margins, in order to counterbalance the effects brought by exchange rate changes on consumer-currency import prices. In textbooks\(^4\), balance-of-payment models assume a one-to-one response of import prices to exchange rates (industries are perfectly competitive and markups are constant and equal to zero); this means there is complete, or full, ERPT (\( \gamma = 1 \)). Two conditions are required to obtain this result:

- constant markups of price over cost;
- constant marginal costs.

2.2 Behaviour of PTM Firms

In the last two decades, exporting firms in industrialized countries have been confronted with unprecedented fluctuations in real exchange rates. It has therefore become more and more

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\(^3\) In this scenario \( 1 - \gamma \) is the markup adjustment.

\(^4\) For example, GANDOLFO G. (1994) studies macroeconomic equilibrium in a standard Keynesian open model; HALLWOOD P.C. - MacDonald R. (1994); DE GRAUWE P. (1997); COLOMBO E. - LOSSANI M. (2002) use the Mundell-Fleming model, which is the IS-LM model extended to an open economy; KRUGMAN P. - Obstfeld M. (2003) use the DD-AA model, which is based on the Mundell-Fleming model and which will be taken as reference in this paper.
important for these firms to find ways to keep their export prices competitive regardless of exchange rate changes.

One solution could be to apply hedging strategies by using ForEx Derivatives. For exporters, the appreciation of the national currency means a decrease in revenues (in national currency) from the sale, in foreign countries, of goods denominated in foreign currency. By using Currency Futures or Currency Options, exporters can avoid that risk, by, respectively, fixing the exchange rate or determining the highest rate at which to convert foreign currency revenues into national currency. But using derivative instruments is not without cost: with currency futures, firms are forced to forfeit any benefits arising from favourable exchange rate changes; with currency options, firms can benefit from favourable exchange rate changes but must pay a premium. Additionally, since firms cannot directly negotiate over-the-counter derivatives, they must employ the services of financial intermediaries, paying the relative commissions.

Therefore many firms prefer to apply pricing strategies instead of hedging strategies. So, for example, in response to the appreciation of national currencies, firms reduce the domestic-currency prices of their export goods in order to stem increases in the foreign-currency prices of the same goods. Pricing-to-Market (PTM) occurs when firms establish their export prices in foreign currency and mark up their marginal costs of production specifically for each export market (destination-specific pricing). In so doing, exporters can apply — simultaneously on different markets — pricing strategies characterized by third-degree price-discrimination policies based on markup adjustments determined by exchange rate changes. For firms to apply this strategy, at least two conditions must be satisfied:

— markets must be geographically segmented;
— firms must have a certain degree of market power.

Since PTM means adopting different strategies on different markets, at this point it may help to describe the behaviour of firms in this context.

Let us consider a firm that sells its products in N foreign markets, indexed by $i$. We assume that in each market demand can be represented by the general formula:
\[ q_{it} = f_{it}(E_{it}p_{it})v_{it} \quad \text{with} \quad i = 1, \ldots, N \quad \text{and} \quad t = 1, \ldots, T \]

where \( q_{it} \) is the quantity demanded by destination market \( i \) in period \( t \), \( p \) is the price in the exporter's currency, \( E \) is the nominal exchange rate (destination market currency per unit of exporter's currency) and \( v \) is a random variable that can shift demand. The exporter's costs are given by:

\[ C_t = C(\sum q_{it})\delta_t \]

where \( C_t \) is a measure of the costs in domestic currency and \( \delta_t \) is a random variable that can shift the cost function (for example, changes in input prices) in period \( t \). The exporter's profit in period \( t \) is:

\[ \prod_t = \sum p_{it}q_{it} - C(\sum q_{it})\delta_t \]

The first-order conditions for maximizing profit require the firm to equate the marginal revenue from sales in each market to the common marginal cost. By substituting the demand functions in the profit function and maximizing with respect to the price charged in each market in each period, a set of first-order conditions is obtained:

\[ p_{it} = c_t \left( \frac{\varepsilon_{it}}{\varepsilon_{it} - 1} \right) \quad \text{with} \quad i = 1, \ldots, N \quad \text{and} \quad t = 1, \ldots, T \]

where \( c_t \) is equal to \( C'\delta_t \), or the marginal cost of production in period \( t \), and \( \varepsilon_{it} \) is the elasticity of demand with respect to the price in local currency in destination market \( i \). The equation above shows that the price in the exporter's currency is a markup.

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5 This first-order condition is generally assumed to be valid for monopolistic operators. However, it can be taken as a general condition if the elasticities are considered to be associated to a residual demand curve that takes into account the firm's perception of its competitor's response to its price changes.
over marginal cost, with the markup depending on the elasticity of demand in the various markets of destination. The smaller the elasticity\(^6\), the higher the markup (for \(\varepsilon \to 1\), \(\varepsilon_{it}/(\varepsilon_{it} - 1) \to \infty\)). The higher the elasticity of demand, the smaller the markup. The same equation can also represent the behaviour of exporters in perfectly competitive markets. In this case demand elasticities are infinite (and independent from destinations) and the firm adopts the output level for which the marginal cost is equal to the world price (for \(\varepsilon \to \infty\), \(\varepsilon_{it}/(\varepsilon_{it} - 1) \to 1\)).

This concept is illustrated in Graph 1. The Graph shows two demand curves having different elasticities; specifically, \(D'\) is more

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\(\varepsilon\) Elasticity must however be greater than 1, because from monopoly theory we know that monopolists who maximize profit can never produce quantities corresponding to the inelastic section of the demand curve.
The demand curves have been designed so that the respective marginal revenue curves, $R_{ma}'$ and $R_{ma}$, intersect the firm's marginal cost curve ($CMa$) in the same point. As known, a profit-maximizing monopolist will produce a quantity ($Q^*$) at which $R_{ma}=CMa$. The markup that the monopolist can apply over marginal costs depends on the elasticity of the demand curve. In markets where the curve is more elastic ($D'$), the monopolist can apply price $P$ and a markup given by the difference between the price and the average cost ($CMe$), which is indicated by the broken segment show by the smaller brace. In markets where the curve is less elastic ($D$), the monopolist can apply price $P'$ and a markup given by broken segment indicated by the larger brace.

It can be seen that when the demand curve is more rigid, monopolists can apply higher markups. It can also be observed that, in markets where demand is more elastic, extra-profit occurs inside the rectangular area $A$, and where demand is less elastic, extra-profit occurs inside the total area of rectangles $A$ and $B$.

2.2.1 Effects of Exchange Rate Changes

To understand the pricing behaviour of firms we can study the works by Marston (1990) and Knetter (1989). Both authors show that the response of export prices to exchange rate changes depend on two factors:

— the convexity of the demand curve in the export market;
— changes in marginal costs.

Let us consider the first factor. Exporters maximize profits in units of national currency, while in importing countries the demand for imports depends on their prices in local currency. Exchange rate changes create a gap between the price paid by the buyer and the price received by the seller in their respective currencies. Given the price of a certain good expressed in the currency of the seller/exporter, a depreciation in the currency of the buyer/importer causes an increase in the local-currency price paid by the latter. Will the selling firm reduce the domestic-currency price of its export goods to contrast the price increase
sustained by the importer due to the depreciation of the latter’s currency? In other words, will the exporter be spurred to resort to local currency pricing stability (LCPS), a pricing policy designed to stabilize prices in the buyer’s currency? The seller’s behaviour, and the answer to our question, depends on the convexity of the demand curves in each country of destination. The convexity of demand determines how the elasticity of demand changes with respect to changes in price. Let us consider two opposite situations.

— Case 1. **Demand curve with constant elasticity in relation to prices (isoelastic curve)**. When the seller meets this type of demand curve, his optimal markup does not change, regardless of price changes caused by the depreciation (or appreciation) of the buyer’s currency. This means that the price charged on each market is a fixed markup on the marginal cost and that no price adjustments are made following exchange rate changes. In short, LCPS is not implemented and pass-through is complete.

— Case 2. **Demand curve with non-constant elasticity in relation to prices (i.e., elasticity changes with changing local-currency prices)**. In this case the export prices charged by the firm depend on the behaviour of the exchange rate. The rule is as follows: if, after depreciation of the buyer’s currency, demand becomes more elastic (or less convex) with the increase of local-currency prices, then the optimal markup charged by the exporter will grow smaller. Vice versa, if demand become less elastic, or more convex, the optimal markup increases. We can infer from this that LCPS produces complete pass-through only when the demand curve becomes more elastic compared to an isoelastic curve, while if the curve becomes more convex LCPS does not take place and the pass-through coefficient is greater than 1 ($\gamma > 1$); in practice, the exporter’s behaviour amplifies the effects of exchange rate changes.

Price adjustments following exchange rate changes ultimately depend on the firms’ perception of how the elasticities of demand vary with respect to local-currency prices. This is illustrated in Graph 2. The Graph shows three different demand curves: an isoelastic curve, a curve that is more elastic and one that is less
elastic. The ordinate axis shows the local-currency prices (currency of the consumer/importer) and the abscissa axis indicates the demand quantities. We will assume that at time $t$ the quantity supplied by the firm (to the foreign market) is at the point of equilibrium $A$, which corresponds to quantity $Q_1$ and price $P_1$. Let us suppose that at time $t+1$ an exchange rate shock causes the depreciation of the buyer’s currency. This provokes an increase in local-currency prices and consequently a reduction in imported quantities from $Q_1$ to $Q_2$. If the firm experiences a constant-elasticity curve, pass-through is complete, as seen above, and the price increase from $P_1$ to $P_2$ is exactly proportional to the exchange rate change. But if, as the local-currency price increases (i.e.,
moves upwards from \( A \), demand becomes more elastic, then the local-currency price will grow less than proportionally, and will no longer be represented by \( P_2 \) but by \( P'_2 < P_2 \). So the firm reduces its profit margins to counterbalance the price increase caused by the depreciation of the buyer’s currency, and pass-through is incomplete. The inverse occurs when the increase in local-currency prices is accompanied by demand becoming less elastic. Despite depreciation, the firm increases its profit margins and the price becomes \( P'_2 > P_2 \). Similar considerations can be made for the case in which the consumer’s currency is appreciated. In this case, appreciation reduces the price of goods in the importer’s currency. Consequently, if the curve becomes more elastic the exporter will increase its markup, and if it becomes less elastic the markup is reduced.

As said at the start of this section, the response of export prices to exchange rate changes can also depend on changes in marginal costs. Marston observes that exchange rate changes can also have a retroactive effect on prices, causing variations in marginal costs. As seen when discussing the pass-through effect, this can occur when exporters employ raw materials (or other factors of production) whose prices are denominated in foreign currency. For example, consider a Japanese firm that makes goods from oil, which is internationally priced in dollars. Let’s assume the firm sells its products in the home market and in the United States. If the dollar appreciates against the yen, the price of oil rises, increasing the firm’s marginal costs of production; in particular, the curve that represents them would shift. Faced with an increase in costs, the firm would raise its prices both for the domestic market and for the United States; in this case too, price adjustments depend on the curvature of the demand curves in the respective markets. This means that cost shocks can affect the relative price of goods only if the demand curves show a different convexity in the two markets. On the other hand, if the convexity of the demand curves is identical, prices will increase by the same percentage on each market and the relative price of the goods will remain unchanged. The appreciation of the dollar can have a further effect on marginal costs: if the price in dollars
of the Japanese export goods diminishes (except when there is zero pass-through and \( \gamma = 0 \)), demand for those goods would grow in the United States and so would the exporting firm’s output. If the growing output level is accompanied by an increase in marginal costs, the output increase causes an increase in marginal costs that can be read, in this case, on the marginal cost curve.

3. - Macroeconomic Implications of PTM

Up to here we have examined Pricing-to-Market from a microeconomic point of view. We have studied the behaviour of firms taking the exchange rate as an exogenous variable.

We will now take a macroeconomic viewpoint; our goal is to understand the implications of PTM on macroeconomic variables (e.g., output, consumption, the current account balance) as well as on the volatility of the exchange rate. Basically, we will conduct a inverse analysis: this time we will assume PTM as the exogenous variable and find out how the international transmission mechanisms of monetary policy vary compared to the case where there is no PTM. To do that, we will examine an important work by Betts and Devereux (2000), who use the model proposed by Obstfeld and Rogoff (1995) to develop an exchange rate model that includes firms that set their prices in the destination market’s currency.

3.1 DD-AA vs. Obstfeld-Rogoff

The New Open Economy Macroeconomics approach is quite different from the classic DD-AA model. In this model it can be said, for example, that in the long run money is neutral, and that a (permanent) expansion in money supply causes overshooting of the exchange rate. Conversely, Obstfeld and Rogoff maintain that money can be non-neutral and that monetary expansion does not imply exchange rate overshooting. Let’s see why.
Graph 3 is a representation of the DD-AA model. The DD curve is the locus of points at which the real market is in equilibrium for given combinations of nominal exchange rates, $E$, and income levels, $Y$. DD has a positive slope, meaning there is a positive relation between nominal exchange rates and income: a depreciation in the exchange rate (an increase in $E$) will stimulate exports and increase output. The AA curve represents combinations of $E$ and $Y$ at which both the money market and the exchange market are in equilibrium. AA has a negative slope, indicating a negative relation between nominal exchange rates and income: an increase in income causes an increase in the transactions demand for money and, for a given money supply, an increase in interest rates, $R$. In this situation, given the foreign interest rate and the expectations on the exchange rate, the domestic currency must be appreciated to bring the exchange
market back to equilibrium\textsuperscript{7}. As can be seen, the only point where both markets are at equilibrium is $e$, where the output level is $Y^o$ and the exchange rate is $E^o$.

Let us consider the short-run effects of an expansionary monetary policy, as shown in Graph 4. Let’s assume that the output level ($Y^o$) corresponding to the point of equilibrium ($e$) is the full-employment level. The increased money supply shifts the $AA$ curve to the right\textsuperscript{8} ($AA'$). The Graph shows that the point of equilibrium shifts from $e$ to $e'$, where the exchange rate has depreciated (from $E^o$ to $E'$) and output has increased (from $Y^o$ to $Y'$).

\textbf{Graph 4}

\begin{center}
\textbf{SHORT-RUN EFFECTS OF EXPANSIONARY MONETARY POLICY ON EXCHANGE RATE AND OUTPUT, IN A FLEXIBLE-RATE REGIME}
\end{center}

\textsuperscript{7}This is because of the ‘interest rate parity condition’, a fundamental condition for exchange market equilibrium, by which the exchange market is in equilibrium when the expected returns on deposits denominated in all currencies are equal, as in $R = R^* + (E^* - E)/E$.\textsuperscript{8} This shift is larger compared to a temporary monetary expansion because the increased money supply affects the expected rate of exchange.
This occurs because monetary expansion generates excess supply in the money market, which reduces interest rates. Lower interest rates generate an outflow of capital, weakening the value of the national currency. In turn, the (nominal and real) depreciation of the exchange rate makes domestic products more competitive, causing a rise in output and, consequently, in exports.

At the short-run point of equilibrium (point e' in Graph 4), output is higher than the full employment level, corresponding to over-intensive employment of labour and capital. There is an upward pressure on prices, as workers demand higher wages and firms raise prices to cover growing production costs. In the long run, the inflationary pressure following a permanent increase in the money supply drives prices to new long-run levels and brings the economy back to full employment. In Graph 5 we can visualize adjustment towards full employment. Initially, the economy is at the point of simultaneous equilibrium, 1. The increase in money supply shifts AA to a new position, AA', and the economy passes to point 2.

**GRAPH 5**

LONG-RUN EFFECTS OF EXPANSIONARY MONETARY POLICY ON EXCHANGE RATE AND OUTPUT, IN A FLEXIBLE-RATE REGIME
At point 2, output is higher than full employment level and the factors of production are overemployed. As illustrated above, the level of prices begins to rise. Since growing price levels gradually reduce the real money supply, AA' moves to the left as prices grow. But at the same time the price increase makes domestic goods more expensive than foreign goods, hindering exports and favouring imports. So DD also shifts left to a new position, DD'. DD and AA' stop moving only when they intersect at full employment level, $Y^\circ$. This occurs at point 3 (DD' and AA'' curves), where the exchange rate and the price level have grown proportionately with the money supply. At this point there are two important considerations to make.

1. *In the long run, money is neutral*; it does not effect long-run variables, such as income.

2. *Overshooting occurs*; the exchange rate’s initial response is stronger than its long-run response. During the adjustment path from short-run equilibrium (point 2) to long-run equilibrium (point 3), the domestic currency actually appreciates (from $E'$ to $E''$) after the initial overshoot (from $E^\circ$ to $E'$).

It can be observed, lastly, that if prices responded immediately to an expanded money supply, the economy would jump directly from point 1 to 3 and there would be no overshooting. The exchange rate would immediately assume its long-run level. We can infer from this that exchange-rate overshooting is a consequence of short-run price rigidity.

The Obstfeld-Rogoff model differs from the classic approach chiefly in the assumptions made. First, an imperfectly competitive market regime is assumed; since the market is not perfectly competitive, output levels are suboptimal. Secondly, microfoundations are assumed. In particular, the model assumes that individuals maximize the following intertemporal utility function:

\[
U_t^i = \sum_{s=t}^{\infty} \beta^{s-t} \left[ \log C_s^i + \chi \log \frac{M_s^i}{P_s} - \frac{k}{2} y_s \left( j^2 \right) \right] 
\]

Equation (6) shows that utility depends positively from
consumption \((C)\) and from real money balances \((M/P)\) but negatively from labour, which in turn is positively related to output \((y)\). The term \(-k/2y_s(j^2)\) captures the loss in utility met by individuals forced to increase output. Solving the short-run system for the differences between domestic and foreign variables, Obstfeld and Rogoff show that the exchange rate can be indicated in two ways\(^9\):

(7) \[ E = (m-m^*) - (c-c^*) \]

and

(8) \[ E = \frac{\delta(1+\theta)+2\theta}{\delta(\theta^2-1)}(c-c^*) \]

where \(m\) and \(m^*\) are, respectively, the domestic and foreign money supplies, and \(c\) and \(c^*\) are, respectively, domestic and foreign consumption. In Graph 6, equations (7) and (8) are represented,

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GRAPH 6

SHORT-RUN EQUILIBRIUM IN THE OBSTFELD-ROGOFF MODEL

Percentage change in exchange rate, \(E\)

Percentage change in relative consumption, \(c-c^*\)

Slope = \(-1\)

Slope = \(\frac{\delta(1+\delta)+2\theta}{\delta(\theta^2-1)}\)

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\(^9\) For the demonstration see OBSTFELD M. - ROGOFF K. (1996, Ch. 10).
respectively, by curves $MM$ and $GG$. The $MM$ curve intersects the ordinate axis at $(m - m^*)$, the response of the equilibrium exchange rate with fully flexible prices; its slope is $-1$, showing a negative relation between $E$ and $c - c^*$, respectively the percentage change of the exchange rate and of relative consumption (between two hypothetical countries). Conversely, the $GG$ curve has a positive slope, equal to

$$\frac{\delta(1+\theta)+2\delta}{\delta(\theta^2-1)}$$

Graph 7 shows the effects of monetary expansion. The initial equilibrium is at the intersection of the Cartesian axes, crossed by the $GG$ curve and the pre-shock $MM$ curve, where $m - m^* = 0$. The broken $M'M'$ curve represents the situation after the monetary shock. The exchange rate and the short-run equilibrium consumption differential lie at the point of intersection between $M'M'$ and $GG$. Following monetary expansion, since prices are sticky, interest rates drop, triggering exchange rate depreciation (since exchange market arbitrage always works to maintain the uncovered interest rate parity condition). Foreign goods become more expensive than domestic goods, causing a temporary increase in demand for domestic goods and stimulating output. Therefore, monetary shocks have real effects on the economy. How can we be sure that producers will always be willing to increase output? When prices are sticky, output is determined by demand, and since monopolists always set prices above marginal costs, they will find it advantageous to meet larger demand with the same prices but increased output.

It is also interesting to note that in this model the domestic currency depreciates less than proportionally with respect to the relative increase in domestic money supply, even in the long run. The reason is the following: short-run depreciation, by shifting world demand towards domestic goods, temporarily increases real national income against foreign income, so local residents, finding themselves richer, will consume part of their increased
income, but, since they want to smooth consumption, they will save a part too\(^{10}\). So while the current account is balanced in the

\(^{10}\) Actually, exchange rate depreciations can also produce negative effects on the national economy, as they reduce the national residents’ purchasing power of foreign goods. In an economy that is far from full employment, the impulse given to the economic cycle by growing exports tends to prevail over the effects caused by the reduced international purchasing power: once the critical elasticities condition is verified, exchange rate depreciations increase the aggregate demand (exports grow) and cause output to converge towards full employment. It follows that depreciation produces real effects. On the other hand, if the economy enjoys full employment, a monetary expansion would unsettle that equilibrium and produce the opposite effect: since the economy is at its natural level of employment, the monetary shock will only cause an expansion in the prices of goods, including
In the short run the national balance of payments marks a current account surplus. Since individuals want to maximize the intertemporal utility function in equation (6), with greater long-run wealth (generated by the current account surplus) national individuals will replace labour with leisure (they will work less), thereby reducing domestic output and also improving the terms of trade (while the opposite is true for foreign individuals). Since, however, for national agents, real income and consumption grow in the long run, the nominal exchange rate does not necessarily depreciate, as with fully flexible prices. Unlike the DD-AA model, the Obstfeld-Rogoff model allows the following considerations:

1. *Money is not neutral, even in the long run.* Monetary shocks can have real effects beyond the duration of nominal rigidities, thanks to the accumulation of short-run wealth via the current account.

2. *Overshooting does not occur.* The exchange rate does not overshoot after a permanent monetary expansion. Returning to Graph 7, it can also be observed that, in this model, the higher the price elasticity of aggregate demand, $\theta$, the smaller the response of the exchange rate. As $\theta \to \infty$, $GG$ becomes more horizontal (see $G'G'$ in Graph 7). In practice, as $\theta \to \infty$, domestic and foreign goods become closer substitutes and, with predetermined prices, small changes in the exchange rate produce wide shifts in demand.

### 3.2 Effects of PTM on the Exchange Rate

In both the classic approach and in the Obstfeld-Rogoff model, the price of goods was set in the currency of the producer/exporter, and not in that of the consumer/importer. There was no local currency pricing (LCP) but simply product currency pricing (PCP); the national currency prices of foreign goods, thereby triggering an exchange rate depreciation. In this case, the exchange rate depreciation would depress the national economy without producing real effects (expansion) on the economy but only a reduction in the purchasing power of foreign goods.
as a consequence, the law of one price (LOP) was always true for all tradeable goods. Expanding on studies showing how deviations from the LOP (law of one price) were too large to be explained by distance and transport costs alone (see, among others, Engel, 1993; Engel and Rogers, 1996), Betts and Devereux (2000) and other authors\textsuperscript{11} extended the Obstfeld-Rogoff model to include international market segmentation, imperfectly competitive firms and local currency pricing (in short, Pricing-to-Market). These studies show that PTM can play a crucial role in determining the exchange rate and in international macroeconomic fluctuations. This would occur because PTM limits the pass-through from exchange rate changes to prices, thereby reducing the classic expenditure-switching effect that those changes would induce and potentially generating a larger exchange rate variability than found in non-PTM models.

In lack of PTM, as in the Obstfeld-Rogoff model, the extent of depreciation following monetary shocks is inversely proportional to the elasticity of demand, $\theta$. Why? The mechanism is the following: exchange rate depreciation causes relative prices to change, producing expenditure switching, by which world demand shifts from foreign to domestic goods. The stronger is $\theta$, the more domestic goods and foreign goods can be substituted, and, consequently, the smaller is the depreciation. But with complete PTM, cross-country goods substitutability is immaterial, because the relative prices of foreign and domestic goods do not change for consumers after an exchange rate shock; so PTM weakens the allocative effect of exchange rate changes compared to the case where prices are set in the seller’s currency (and pass-through is immediate). Since PTM reduces expenditure switching, the equilibrium exchange rate response is amplified.

Although the Betts-Devereux model is grounded on different theoretical premises, this effect can be represented in a diagram using the $DD-AA$ model. Observe Graph 8. The Graph shows the

\textsuperscript{11} The model presented in \textsc{Betts C. - Devereux M.} (2000) is considered representative of this class of PTM models. Other PTM models are discussed in \textsc{Betts C. - Devereux M.} (1996, 1997, 1999a,b); \textsc{Chari V.V. - Kehoe P.J. - McGrattan E.R.} (1998, 2000) and \textsc{Bergin P.R. - Feenstra R.C.} (2000a,b).
usual $DD$ and $AA$ curves plus another $DD$ curve called $DD_{ptm}$. The $DD_{ptm}$ curve shows how PTM cancels the expenditure switching effect. When describing the classic approach, it was explained that the $DD$ curve has a positive slope because a depreciation in the exchange rate (an increase in $E$) reduces the price of goods produced in the country where the depreciation occurs; this stimulates exports, which increases output. In the $DD$-$AA$ model, prices are set in the seller’s currency and there is no PTM. However, if PTM is assumed, exchange rate changes do not imply an adjustment of relative prices. How does the $DD$ curve change? It becomes more rigid, or vertical$^{12}$, because the output level does not depend on the exchange rate.

$^{12}$It should be recalled that the $DD_{ptm}$ curve is inelastic, since we are assuming complete PTM, meaning that all firms adopt a PTM strategy and pass-through is zero. More generally speaking, the smaller the exchange rate pass-through (and therefore the higher the degree of PTM), the lower the elasticity of the $DD_{ptm}$ curve.
Exchange rate changes do not make it more convenient to buy goods made in the country whose currency has depreciated, because relative prices remain unaffected. Consequently, there is no boost to exports that would increase output. When there is complete PTM, real-market equilibrium can no longer be observed on the $DD$ curve; with PTM, the locus of points of real-market equilibrium is represented by the $DD_{ptm}$ curve. It can easily been seen what happens when the economy is affected by a monetary shock. Let’s assume that — in either presence or absence of PTM — the money market and the real market are both in equilibrium and that the output level is $Y_1$. Following monetary expansion, $AA$ shifts to $AA'$. With no PTM, the exchange rate depreciates (from $E$ to $E'$) and output increases (from $Y_1$ to $Y_2$). With PTM, output does not change and the depreciation of the exchange rate is amplified ($E'' > E'$).

It must be noted, however, that the fact that output does not increase in absence of PTM does not imply invariance of consumption. The depreciation increases profits for domestic PTM firms, with a redistribution of income in the home country that stimulates domestic against foreign consumption.

The cause of this should not surprise. With reference to Graph 2, for domestic PTM firms the depreciation in the exchange rate would correspond in this case to an appreciation of the currency of the consumer/importer (moving from $A$ to the right); the appreciation reduces the price of goods in the importer’s currency, and since, as assumed, demand elasticity is greater than 1, domestic PTM firms will increase their markup. But for the foreign country the currency of the consumer/importer has depreciated; this depreciation increases the price of goods in the importer’s currency, and foreign PTM firms will reduce their markups to counterbalance the price increase.

In this manner, exchange rate depreciation causes a redistribution of income that benefits the home country; as a result, domestic consumption grows against foreign consumption. This occurs despite the inertia of relative prices following the exchange rate change. In conclusion, the redistribution of income is caused not by a shift in household demand towards domestic products,
but by opposite, symmetric variations in the profits of PTM firms, positive for home firms and negative for foreign firms.

3.3 Effects of PTM on the Terms of Trade

PTM plays a fundamental role not only in determining the exchange rate, but also on the impact that exchange rate changes have on the terms of trade. It is generally assumed that, by increasing the price of imports and reducing the price of exports, exchange rate depreciation negatively affects the terms of trade. In fact, in the presence of PTM, exchange rate depreciation can actually improve the terms of trade. Betts and Devereux (2000) show that the terms of trade, $\hat{\tau}$, can be expressed as follow:

\begin{equation}
\hat{\tau}_t = (2s-1) \cdot \hat{E}_t
\end{equation}

where $s$ is the degree of PTM and $\hat{E}_t$ is the exchange rate. The equation shows that the direction of terms of trade movement depends essentially on the degree of PTM. We will consider three situations.

— Case 1. No PTM. When $s = 0$, the terms of trade deteriorate. Since, in this case, prices are set in the currency of the exporter, an exchange rate depreciation will increase prices in the importer’s currency but leave export prices unchanged.

— Case 2. Generalized PTM. When $s = 1$, the terms of trade must improve. Prices are set in the currency of the importer, so an exchange rate depreciation will increase prices in the exporter’s currency but leave import prices unchanged.

— Case 3. Partial PTM. When $s = 1/2$, the terms of trade remain unchanged. In this situation, the increase in export prices following exchange rate depreciation is completely cancelled by the increase in import prices. It can be inferred that, following depreciation, the terms of trade improve for values of $s > 1/2$.

Graphs 9 and 10 show, respectively, how the terms of trade change following depreciation ($\Delta^*E$) or appreciation ($\Delta^*E$) of the exchange rate, for various degrees of PTM. It can be observed that
exchange rate changes have opposite effects on the terms of trade, depending on the degree of prevalence of PTM behaviour in the economy. When $0 < s < 1/2$, the terms of trade improve following an appreciation of the exchange rate and worsen after a depreciation. When $1/2 < s < 1$, the terms of trade improve following a depreciation of the exchange rate and worsen after an appreciation. When $s = 1/2$, the terms of trade remain unaffected by exchange rate changes.

Graphs 9 and 10 also show that it is not only the direction of change (improvement/worsening) of the terms of trade that depends on the degree of PTM, or $s$, but the extent of change too. In particular, the figures show that when there is no PTM behaviour ($s = 0$) or only PTM behaviour ($s = 1$), changes in the
terms of trade are exactly proportional to changes in the exchange rate: when \( s = 0 \), \( \hat{\tau}_t = -\hat{E}_t \) after exchange rate depreciation and \( \hat{\tau}_t = \hat{E}_t \) after exchange rate appreciation; similarly, but with opposite signs, when \( s = 1 \), \( \hat{\tau}_t = \hat{E}_t \) after exchange rate depreciation and \( \hat{\tau}_t = -\hat{E}_t \) after appreciation.

When PTM behaviour is partially present (0 < \( s < 1 \)), change in the terms of trade is less than proportional to exchange rate changes; more precisely, the more \( s \) approaches 0.5, the smaller is the change. As explained above, as \( s \to 1/2 \), \( \hat{\tau}_t \to 0 \). This is shown in Graph 11. If we calculate the partial derivative of the absolute value of the terms of trade with respect to the exchange rate, we obtain two maximums (for \( s = 0 \) and \( s = 1 \)), and one minimum (\( s = 1/2 \)). The maximum and minimum values, of course, are 1 and 0, respectively.
3.4 Monetary Shocks and Real Variables

We will now try to assess the impact of monetary shocks on consumption, output and income in the exporting country and in the importing country. Our goal is to verify whether in PTM economies money is neutral, contrarily to the Obstfeld-Rogoff model which does not contemplate PTM.

We will first consider the short run. With no PTM, unanticipated monetary expansion increases consumption in both countries. Intuitively, if there is a strong pass-through for the depreciation of the domestic currency, the foreign price index tends to fall, stimulating foreign consumption through money market equilibrium. Also, depreciation caused by domestic monetary expansion triggers expenditure switching, shifting buyers’
preferences towards home goods, thereby increasing output (and consumption) levels at home but reducing output in the other country. As a consequence, with no PTM, monetary shocks tend to produce high, positive comovements of consumption between the countries, but large, negative comovements of output. In other words, while there is positive international transmission of monetary shocks on consumption, international transmission of shocks on output is negative.

The situation changes when there is PTM behaviour, that is, when $s \to 1$. As $s$ grows, exchange rate depreciation pass-through is reduced, limiting the impact of monetary shocks on output but strengthening the impact on home consumption. This means that the larger is $s$, the smaller is the exchange rate pass-through on the relative prices met by consumers in both countries. Therefore the impact on output in both countries is chiefly determined by the direct growth of domestic consumer demand. As described above, when there is zero pass-through ($s = 1$), expenditure switching does not take place and domestic demand (and consumption) increases over foreign demand thanks to the increase in income produced by the increase in firm profits. Additionally, when $s = 1$, the increase in domestic demand is the same for goods of national and foreign origin. Therefore real output grows in both economies by an amount equal to the increase in world consumption. These results show that, in a system hit by international monetary shocks, PTM behaviour should reduce cross-country consumption correlations while at the same time increasing output correlations. Thus, while with no PTM cross-country comovements of consumption are positive and comovements of output are negative, the situation is reversed if PTM is taken into account: deviations from PPP (purchasing power parity) caused by PTM behaviour reduce comovements of consumption; but at the same time the lack of expenditure switching following exchange rate changes strengthens cross-country comovements of output.

To assess the impact of monetary shocks on income, movements of output and consumption can also be interpreted considering adjustments in the terms of trade. In the extreme case
when \( s = 1 \) (and \( \varepsilon = 1 \))\(^{13} \), while a domestic monetary shock also increases foreign output, it has the additional effect, illustrated above, of deteriorating the foreign country's terms of trade (domestic monetary shocks cause the appreciation of the foreign currency, and, when \( s = 1 \), a worsening of the terms of trade, since \( \hat{t}_i = -\hat{E}_i \); see Graph 10). The deterioration of the terms of trade counterbalances the growth in foreign output, with the final result that foreign income remains unvaried. Vice versa, in the home economy, the combination of increased output and improved terms of trade caused by the depreciation of the domestic currency and the presence of PTM (see Graph 9) produces a raise in income.

We now turn to the long run. To assess the long-run impact of monetary shocks on consumption and output we must consider the response of the trade balance. Betts and Devereux show that the trade balance

\[
\left( \frac{\beta dF_t}{\tilde{P}\tilde{C}^W} \right)
\]

is given by:

\[
(10) \quad \frac{\beta dF_t}{\tilde{P}\tilde{C}^W} = (1 - n) \sigma / r \cdot \frac{(\theta - 1)(1 - s)}{1 + \sigma / r} \cdot \hat{E}_i
\]

Monetary expansion usually improves a country's trade balance. The improvement, however, is inversely proportional to \( s \). As \( s \rightarrow 1 \), the right-hand side of the equation approaches zero. Therefore the current account balance is not affected by exchange rate changes brought by monetary shocks. In this case, domestic income and consumption increase by the same percentage. Although consumers generally prefer to employ part of their increased income to increase future consumption (that is, they want to smooth consumption), the fall in real interest rates

\(^{13}\) Where \( \varepsilon \) is the consumption elasticity of money demand.
encourages them to spend all their increased income at once. But since the foreign real interest rate does not change due to national market segmentation\textsuperscript{14}, it remains higher than the domestic rate; this deters foreign residents from contracting loans. Consequently, where there is complete PTM, monetary shocks do not affect the trade balance. It can be inferred from this that the long-run effects of monetary shocks on consumption and output are inversely proportional to $s$.

Examining the Obstfeld-Rogoff model we have seen that money is not neutral, since unanticipated monetary expansion improves the current account balance and consequently increases consumption even in the long run. But with complete PTM, the impact of a monetary shock is felt only in the short run, since it does not affect the current account balance. We can conclude that, in the long run, PTM favours complete money neutrality.

3.5 \textit{Beggar-thy-Neighbor or Prosper-thy-Neighbor?}

What effect do monetary shocks have on welfare? In the classic approach, and chiefly in the Mundell-Fleming model, monetary policy favours the nation whose currency depreciates, since depreciation makes domestic good cheaper and stimulates exports. But there are effects on the other country as well. Currency appreciation makes domestic goods more expensive on international markets, and this reduces exports.

Employing definitions used in literature, we can say that in this case monetary policy is a prosper-thyself and beggar-thy-neighbor instrument, because expansionary monetary policies improve the conditions of the nation that implements them and worsens the conditions of its trading partners.

\textsuperscript{14} Betts and Devereux show, with their model, that cross-country real interest rates can differ because of deviations from PPP induced by international market segmentation. In particular, they note that the domestic real interest rate always drops following a domestic monetary expansion, while the direction of change in the foreign real interest rate is ambiguous. But when $\varepsilon = 1$ and $s = 1$, foreign real interest rates are not affected by domestic monetary shocks. Therefore, with PTM, the \textit{ex post} domestic and foreign real interest rates are different.
Our aim is to understand the welfare effects of monetary policies in an economy that includes firms that practise PTM. We will try to understand if monetary expansion is a beggar-thy-neighbor or a prosper-thy-neighbor instrument.

To do so we will examine the model presented in Otani (2002). Otani extends the Betts-Devereux model in order to study the effects of price-setting asymmetries on exchange rate volatility and on international monetary policy transmission. This model is especially useful because it includes as particular cases both the Obstfeld-Rogoff model and the Betts-Devereux model. This makes it possible to study the effects of monetary policy with varying degrees of domestic and foreign PTM. Observe Graph 12. The ordinate axis shows the degree of domestic PTM (s), and the

**Graph 12**

**INTERNATIONAL TRANSMISSION OF DOMESTIC AND FOREIGN MONETARY POLICY, WITH PTM**

(The Betts-Devereux situation)

\[ s = s^* \]

Beggar-thy-neighbor foreign monetary policy

Beggar-thy-neighbor domestic monetary policy

(The Obstfeld-Rogoff situation)
abscissa axis shows the degree of foreign PTM \((s^*)\)^15. The point of intersection between the Cartesian axes represents the situation described by Obstfeld and Rogoff, which does not contemplate PTM and for which \(s = s^* = 0\). The situation described by Betts and Devereux can be read along the broken line that leaves the origin with a 45° slope; Betts and Devereux contemplate PTM firms but not asymmetric price-setting (where \(s \neq s^*\)), therefore, \(s = s^* > 0\).

Otani shows that all points above line A represent combinations of \(s\) and \(s^*\) for which a foreign monetary expansion has beggar-thy-neighbor effects, while all points below the line represent combinations of \(s\) and \(s^*\) for which a foreign monetary expansion has prosper-thy-neighbor effects. Similarly, the author shows that all points above line \(B\) represent combinations of \(s\) and \(s^*\) for which a domestic monetary expansion has beggar-thy-neighbor effects, while all points below the line represent combinations of \(s\) and \(s^*\) for which a domestic monetary expansion has prosper-thy-neighbor effects.

As can be seen, the two lines divide the diagram into 4 regions. In region (I), monetary expansion, whether domestic or foreign, has prosper-thy-neighbor effects. In region (IV) both domestic and foreign monetary expansion have beggar-thy-neighbor effects. It can be observed that the Obstfeld-Rogoff model, which does not consider PTM, falls into region (I). Their Redux model shows that monetary shocks, whether symmetric (equiproportional increases in money supply) or asymmetric, improve welfare in both countries. This happens because, in an imperfectly competitive market system like the one assumed by the model, output levels are inefficiently low, and the only first-order effect of monetary expansion is to increase output and make it converge towards a socially optimal level corresponding to perfect competition. The Betts-Devereux model, which does include PTM, falls into region (IV). In this model, when PTM is sufficiently widespread, monetary policy is a beggar-thy-neighbor instrument; the reason

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15 In this model \(s\) and \(s^*\) can take any value from 0 to 1, since they represent the percentage of firms that apply PTM price-setting strategies. Therefore, while \(s\) and \(s^*\) represent the percentage of (domestic and foreign) PTM firms, \(1 - s\) and \(1 - s^*\) represent the percentage of (domestic and foreign) non-PTM firms.
is evident if we recall the effects of PTM on the terms of trade. When $s > 1/2$, meaning PTM is prevalent in the economy, depreciation improves the terms of trade while appreciation worsens them. Therefore an expansionary domestic monetary policy, by depreciating the home currency and appreciating the foreign currency, worsens the foreign country’s terms of trade. Foreign residents reap less benefits, in terms of consumption, from world output expansion, and increase their labour supply to meet the other country’s growing demand. The result is that foreign residents find themselves worse off.

The new contribution from Otani regards the existence of regions (II) and (III). In these two regions the effects of monetary policies are asymmetric. For example, in region (II), where domestic PTM is relatively high and foreign PTM relatively low, domestic monetary expansion has beggar-thy-neighbor effects, while foreign monetary expansion has prosper-thy-neighbor effects. The opposite happens when foreign PTM is relatively high and domestic PTM is relatively low, as in region (III): in this case, an increase in the domestic money supply has prosper-thy-neighbor effects, while the same in the foreign economy has beggar-thy-neighbor effects.

It should be noted that the external effects of monetary policies are asymmetric as long as the percentage of domestic PTM firms falls within a certain range. When the percentage of foreign PTM firms is low and the percentage of domestic PTM firms is very high, we are in region (IV), where both countries’ monetary policies have beggar-thy-neighbor effects.

We can conclude then that when asymmetric price-setting behaviour is assumed, the welfare effects of monetary policies cannot be predicted. In order to make a reasonable forecast we need to know the degree of PTM, not only in the home country but in the trading-partner countries as well.

4. - Conclusions

We can now conclude this paper by answering the questions
posed at the start. In the presence of segmented markets and variable-elasticity demand curves, in order to maintain their market quotas, producers/exporters are likely to apply PTM and LCPS strategies, absorbing exchange rate changes through markup adjustments and thereby causing incomplete pass-through. It derives from this that, although exchange rate changes imply changes in import prices, these changes are often less than proportional. Having compared the classical theories of open economy macroeconomics (which contemplate perfectly competitive markets) with those of the New Open Economy Macroeconomics (which contemplate microfoundations and imperfect competition), we conclude with the following considerations.

— PTM causes exchange rate overshooting. It has been shown that in economies characterized by widespread PPP and absence of PTM, expenditure switching induced by exchange rate fluctuations tends to limit the fluctuations themselves, while in economies where PTM is prevalent expenditure switching is low and exchange rate fluctuations are amplified.

— In the presence of PTM, exchange rate depreciation causes a redistribution of income that benefits the home country. The redistribution of income is caused not by a shift in household demand towards domestic goods, but by opposite, symmetric variations in the profits of PTM firms, positive for domestic firms and negative for foreign firms.

— In the presence of PTM, monetary policy is neutral in the long run. From the Obstfeld-Rogoff model we have seen that money is not neutral, since unanticipated monetary expansion improves the current account balance and consequently increases consumption, even in the long run. But with complete PTM, the impact of a monetary shock is felt only in the short run, since it does not affect the current account. We can conclude that, in the long run, PTM enhances complete money neutrality.

— Following exchange rate depreciation, PTM can improve the terms of trade instead of making them deteriorate. When prices are set in the importer’s currency, exchange rate depreciation increases prices in the exporter’s currency but leaves import prices unchanged.
— **PTM reverses the order of output and consumption comovements.** In lack of PTM, monetary shocks tend to produce high, positive cross-country comovements of consumption, but large, negative comovements of output. On the other hand, when PTM is prevalent, deviations from PPP caused by PTM behaviour reduce the comovements of consumption; but, at the same time, the lack of expenditure switching following exchange rate changes strengthens cross-country comovements of output.

— **It cannot be said, a priori, whether PTM makes monetary policy a beggar-thy-neighbor or a prosper-thy-neighbor instrument.** We have seen that if domestic and foreign firms follow different price-setting behaviours the external effects of domestic and foreign monetary policies can be asymmetric. For example, if the percentage of domestic PTM firms is high and the percentage of foreign PTM firms is low, an increase in domestic money supply can have beggar-thy-neighbor effects, while a foreign monetary expansion can have prosper-thy-neighbor effects, improving welfare in the home country.

It appears evident that, in economies where PTM is widespread, the effects of monetary policy on macroeconomic variables can differ from those predicted by the classical theories of open macroeconomics. It is therefore essential for policymakers to empirically verify the extent of PTM behaviour, and this leaves ample space for future research.
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