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EFFETTI DELLA SVALUTAZIONE SULL'INFLAZIONE

Why Has Inflation Remained So Low After the Large Exchange Rate Depreciations of 1992?*

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Abstract

This article explains why inflation failed to accelerate in industrial countries after the large exchange rate depreciations of 1992–93. The degree of pass-through from exchange rate changes to inflation is assumed to depend on the degree of openness of the country, on unutilized capacity at home and abroad, on the price of oil and on the wage, fiscal and monetary policies followed by the country after devaluation. Inflation equations are then estimated for consumer and wholesale prices using pooled data referring to 80 episodes of devaluations/depreciations for seven industrial countries during the period 1966–93. The tests show that the macroeconomic policy followed by the country significantly influences the degree of pass-through and that the 1992–93 episodes do not constitute a break with respect to previous devaluation episodes when inflation accelerated sharply.

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I. Introduction

The fact that inflation failed to accelerate in virtually all industrialized countries which experienced a major devaluation after September 1992 was a major surprise to most observers, and seems to constitute a break with respect to the experience of the large devaluations in the 1970s. For instance, in Italy, consumer price inflation fell from 5.0 per cent in the third quarter of 1992 with respect to the same quarter of the previous year, to 4.0 per cent in the last quarter of 1994, after reaching a through of 3.7 per cent in the June of the same year. This occurred despite the large depreciation of the lira of 38 per cent with respect to the Deutschmark from August 1992 to the end of 1994. On the other hand, inflation accelerated from 7.2 per cent in the last quarter of 1972 to 24.7 per cent in the last quarter of 1974, a period during which the lira had depreciated by 48.2 per cent with respect to the DM; and similarly inflation accelerated from 11.6 per cent in the last quarter of 1975 to 21.1 per cent in the last quarter of 1976, a period during which the lira had depreciated by 42.1 per cent with respect to the DM. These episodes are compared in Table 1. It goes without saying that inflation is not determined by the depreciations of the exchange rate alone. For instance, the increase in the price of oil must have played an important role in the acceleration of inflation in Italy in the first and third episodes. In addition, the changes in the exchange rate of the DM reported in Tables 1 and 2 may overestimate the changes in the nominal effective exchange rate. This is to some extent the case in the last episode.[1] The fact that the lira depreciated less with respect to the US dollar than with respect to the DM during the 1992–95 episode may be important because most imports of raw materials are invoiced in dollars. Furthermore, the lack of a pass-through in the 1992–95 episode may also be explained by the high overvaluation of most currencies in August 1992.

Table 2 summarizes the changes in the inflation rates and the depreciations with respect to the DM of a number of industrial countries in the 1992–95 episode

Table 1: Italy – Depreciation of the Exchange Rate and Consumer Price Inflation, Four Episodes Compared (%)

Episodes	*1972q4–74q4*	*1975q4–76q4*	*1978q2–80q2*	*1992q2–94q4*
Depreciation[a]	48.2	42.1	15.8	37.5
Initial inflation[b]	7.2	11.6	12.1	5.0
Final inflation	24.7	21.1	20.9	4.0

Source: IMF, International Financial Statistics.
Notes: [a] With respect to the DM; end of period data.
[b] With respect to the same quarter of the previous year.

[1] On the degree of overestimation, see fn 5 on page 337.

Table 2: Consumer Price Inflation and Depreciation in Industrial Countries after June 1992 (%)

	Depreciation[a,]	*Inflation[b]*	
	(June 1992–Dec. 1994)	*August 1992*	*December 1994*
Italy	37.5	5.2	4.0
UK	21.7	3.6	2.9
Spain	33.1	5.7	4.3
Portugal	23.7	9.0	4.0
Sweden	34.6	2.0	2.2
Finland[c]	15.6	2.3	1.6
Greece	28.0	15.3	0.8
Norway[c]	14.7	2.3	1.8

Source: IMF International Financial Statistics.
Notes: [a] With respect to the DM; end of period data.
[b] With respect to the same month of the previous year.
[c] June 1992–October 1994.

and shows that the reduction of inflation is a generalized phenomenon in spite of the large depreciations.

In this article, we approach the issue by estimating inflation equations in which exchange rate changes, together with changes in other cost push variables, are assumed to play a role in determining inflation along with aggregate demand variables. Money is not included, however, as it is frequently also an important determinant of the exchange rate, and hence we would have run into problems of multicollinearity if we had included it among the regressors along with the exchange rate. We isolate 80 episodes of devaluations drawn from the 1967–93 experience of seven industrial countries, and pool them to estimate our inflation equations.

The article is structured as follows: Section II presents the theoretical model. Section III describes the construction of the data and presents the tests for consumer and wholesale prices. Section IV summarizes the main results and concludes.[2]

II. The Theory

The extent to which currency depreciations are passed through into domestic price increases can be analysed by distinguishing three stages of the transmission process from depreciation to domestic inflation.

[2] Data relating to the countries and episodes used in the study, along with details of the sources and definitions used, are available from the first author.

(1) The first stage is the pass-through from currency depreciation to increases in import prices. There is a large literature analysing this pass-through. For a survey of the literature, see Costa (1996). Here we use a simple mark-up model of a representative firm supplying the domestic market with a particular good or service. The model is based on Hooper and Mann (1989). The foreign producer faces a downward sloping demand curve in the domestic market. For the sake of simplicity, we assume that the producer works under constant return to scale so that his marginal cost curve is a horizontal line. We represent the model graphically in Figure 1 (for more detail, see Hooper and Mann, 1989).

On the vertical axis we set the import price (in domestic currency), and on the horizontal axis the quantities imported. The domestic demand curve and the associated marginal revenue curves are represented by D and MR, respectively. The foreign firm produces at the marginal cost C^*, which is expressed in foreign currency so that C^*S is the domestic currency translation of C^*: S is the exchange rate (the price of the foreign currency in units of the domestic currency). Note that when costs and prices increase in the foreign country (due to say generalized inflation) C^* increases.

At the exchange rate S_1 the optimum price and quantity combination is given by P_1 and Q_1. Note that the mark-up is given by the distance between P_1 and C^*S. Its size depends on the price elasticity of the domestic demand. It can be written as follows.

$$P_1 = e/(e+1)\, C^* S \qquad (1)$$

where e is the price elasticity of the domestic demand.

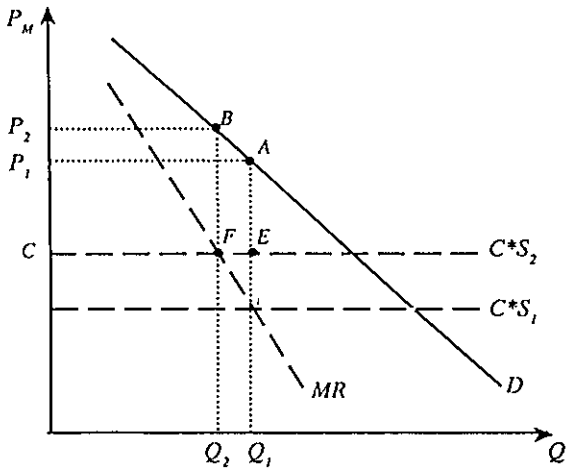

Figure 1: Mark-up Model of the Pass-through

Suppose that the domestic currency depreciates from S_1 to S_2. The new equilibrium combination of price and quantity is now given by P_2 and Q_2. In general, if the price elasticity of demand is constant, the pass-through will be complete, i.e. a depreciation of say 10 per cent will lead to an increase of the import price of 10 per cent. This can be seen by writing the new pricing rule.

$$P_2 = e/(e+1)\, C^* S_2 \qquad (2)$$

Comparing equation (2) to (1), it can be seen that if e remains constant, an increase in S leads to the same proportional increase in P. Note also that a depreciation of the domestic currency and a foreign price increase (which increases C^*) have the same effects on the import price.

Recent theoretical developments allow us to identify the factors that will lead to less than full pass-through (see Krugman, 1987; Baldwin, 1988). The first thing to note from Figure 1 is that the increase in profit resulting from increasing the domestic price after devaluation, is of a second order of magnitude. This can be seen as follows. The profit after the devaluation when the firm adjusts its price upwards is given by the rectangle CP_2BF. Compare this with the profit after the devaluation if the firm were to choose not to increase its price. This is equal to the rectangle CP_1AE. The difference between the two rectangles will be small (of second order) if the demand is relatively elastic. This follows from the fact that raising the price after the devaluation has two opposing effects on profits. It increases the margin on every unit sold. At the same time it reduces the quantity sold. With a relatively elastic demand, the latter effect is also relatively large. As a result, the gain in profits from adjusting the price upwards after the devaluation is of a second order of magnitude. This phenomenon may lead the foreign firm not to raise its price. This will happen if there is some small cost of raising prices ('menu costs') and if the firm believes that the depreciation may not be a permanent one. For, in the latter case, the foreign firm incurs a cost today by raising its price, knowing that if in the future the depreciation is reversed, it may have to incur new 'menu' costs to adjust its prices downwards again. Under those conditions the firm may decide to keep its price relatively fixed, and let its profit margin adjust to the (easily reversible) exchange rate changes.

(2) The second stage in the transmission of the exchange rate changes to domestic prices concerns the channel between import prices and domestic prices. This stage in the transmission process will be much influenced by the economy. In a relatively open economy, the share of imported goods in the domestic consumption basket is large so that a given import price increase has a large effect on the domestic prices.

(3) The third and final stage describes the wage price dynamics following the depreciation. As domestic prices adjust upwards following the currency depreciation, wage adjustments are set in motion. The factors that affect the strength

of this dynamics are influenced by the degree of slack in the labour market and the state of aggregate demand. When the economy is in a recession characterized by weak aggregate demand and increasing unemployment, wage adjustments following domestic price increases will be weak, reducing the overall pass-through of the currency depreciation. In this connection, the fiscal policy stance will be important. When the fiscal authorities choose to follow restrictive fiscal policies after the currency depreciation, this will temper the wage–price spiral, thereby also reducing the pass-through.

We conclude this theoretical discussion by listing the variables that will affect the degree to which currency depreciation raises domestic prices. Generally speaking this pass-through will be positively affected by:

- the extent to which currency depreciations are perceived to be permanent;
- the size of the foreign price increases that accompany the currency depreciation;
- the degree of openness of the domestic economy;
- the state of aggregate demand in the domestic economy;
- the degree of fiscal policy stimulus.

In a previous study De Grauwe and Tullio (1994) approach the analysis of the very low pass-through of exchange rate depreciations to consumer price inflation in the post-1992 episode by studying 23 cases of devaluations for seven industrial countries during the period 1964–86, starting with the devaluation of the UK pound in 1967. In cross-country estimates of an inflation equation based on these 23 observations, they find an average pass-through of depreciations of the nominal effective exchange rate to consumer price inflation of 0.3–0.4 and a very significant and negative effect of real interest rates on inflation.[3] They conclude that the very low pass-through in the 1992–94 episode is explained by the very high real interest rates. For instance, real interest rates in Italy were around 8–10 per cent from mid-1992 to mid-1993, an all-time record for the whole post-war period, much higher than in countries which appreciated their currency or depreciated it by less.

They fail to find in their study a direct significant effect of wages, of the business cycle, of aggregate demand or of fiscal policy on inflation. At least in the case of Italy, it is plausible to assume that the low pass-through in 1992–94 is also caused by very moderate wage growth, by the very weak domestic and international business cycles and by the unprecedented fiscal restriction which led in 1993 to a fall in real domestic demand of 5 per cent. In this article we re-estimate their inflation equation on a larger sample of 80 episodes to test the robustness of their results to additions of new variables, to changes in the

[3] The degrees of freedom in De Grauwe and Tullio are 16.

definitions of the variables, to lags taken into account and to changes in the countries considered.

The main objective of this article is to show that the 1992–95 episode does not constitute a break with the past, and that its different outcome in terms of inflation is fully explained by the very low level of economic activity and/or by the thrust of domestic economic policies (fiscal, monetary) which determine economic activity.

The main novelty of this article is the increase in the number of episodes from 23 to 80. In addition we estimate the pass-through also for wholesale prices, we include in the sample the last episode of large exchange rate changes using data up to the 2nd quarter of 1993, and we try different specifications of the inflation equation.

The seven countries chosen are: France, Sweden, Italy, the UK, Spain, Japan and Australia. In the De Grauwe and Tullio (1994) study they were the first four plus Ireland, Belgium and the Netherlands. The three countries added to the sample show wider and more numerous variations of exchange rates than the three European countries left out; in addition, it was thought useful to add Japan which differs substantially in the degree of openness and experienced more appreciations of the currency than any country in the old sample.

Once the group of countries and the sample period were decided, we identified the quarter during which a significant depreciation or appreciation occurred (quarter t). We then define period A as the period from quarter t–4 to quarter t–1 (the 'reference' period) and period B from quarter t to quarter t+3 (the 'turbulent' period). Next, we define the rate of inflation of period B as the percentage change of the price level in quarter t+3 with respect to quarter t–1, and the rate of inflation of period A as the percentage of the price level in quarter t–1 with respect to quarter t–5. Our dependent variable is the rate of inflation of period B as measured above minus the rate of inflation of period A. The periods A and B together (from quarter t–4 to quarter t+3) form one eight-quarter 'episode'.[4] Thus our episodes cover in general eight quarters and allow for slightly less than a one-year lag in the transmission of exchange rate depreciations to inflation as opposed to 16 quarters and slightly less than a two-year lag in the previous paper. By considering only one year after the large depreciation (or appreciation), we run the risk of not catching its full effect on inflation; however, we gain degrees of freedom. For the same reason on some occasions the episodes are partly overlapping.

The first equation estimated is:

$$\pi_B - \pi_A = \alpha_0 + \alpha_1\left(\bar{\dot{S}}_B - \bar{\dot{S}}_A\right) + \alpha_2\left(\bar{r}_B - \bar{r}_A\right) + \alpha_3\left(\dot{p}_{OIL,B} - \dot{p}_{OIL,A}\right) + \alpha_4 V\%\left(\bar{d}_B, \bar{d}_A\right) \qquad (3)$$
$$+\alpha_5\left(\dot{IP}_B - \dot{IP}_A\right) + \alpha_6\left(\pi_{E,B} - \pi_{E,A}\right) + \alpha_7\left(\dot{W}_B - \dot{W}_A\right) + \alpha_8 OP$$

[4] In a few cases, the period A and/or B included five rather than four quarters.

where:

π_B = the rate of inflation of period B measured as the percentage change of the price level in quarter t+3 with respect to quarter t–1

π_A = the rate of inflation of period A measured as the percentage change of the price level in quarter t–1 with respect to quarter t–5. When the quarters in a period are five, the rate of inflation has been annualized (by multiplying by 4/5). Thus the dependent variable is the change in annual inflation (acceleration of the price level) from the reference period to the turbulent one

S = bilateral nominal exchange rate of the domestic currency with the DM for European countries or with the US dollar for Japan and Australia, defined as the number of domestic currency units for one unit of foreign currency

r = real interest rate

p_{oil} = petroleum price level in US dollars

d = real domestic demand

IP = industrial production

π_E = foreign inflation rate

W = nominal wage

OP = degree of openness of the economy

a dot above a variable or a $V\%$ in front of it stands for a percentage change, a subscript 'E' stands for a foreign variable, the subscript 'c' for consumer prices, the subscript 'w' for wholesale prices and the symbol – stands for a four or five-quarter average.

In equation (3) the change in inflation between the two periods is assumed to depend on the behaviour of the exchange rate (S), of the real interest rate (r), of the price of oil (p_{oil}), of domestic demand (d), of industrial production (IP), of the foreign inflation (π_E), of nominal wages (W) and the degree of openness of the economy (OP). The list of variables initially included in equation (3) comprised also fiscal policy (as a substitute for d) and a dummy for the fixed exchange rate period and one for appreciations, where the latter was intended to test for the existence of asymmetries. The expected sign of the coefficients is positive except for α_2.

Four observations are in order. First, the real interest rate in equation (3) contains inflation, which is also the dependent variable. Hence the estimated coefficient of the real interest rate may be biased towards –1 if nominal interest rates react sluggishly to inflation. Therefore we have to be careful in interpreting the size and significance of this coefficient. This holds more for the consumer price equations than for the wholesale price equations, as we use consumer prices to calculate real interest rates.

Second, the rates of changes of industrial production and real domestic demand are proxies for excess capacity. Data on excess capacity are not very reliable in several countries and they are also difficult to find. In order to avoid these problems we have preferred the specification given in equation (3). Industrial production changes are assumed to influence inflation from the demand side. Fiscal and monetary policies are assumed to influence capacity (the business cycle) and through it inflation.

Third, the exchange rate used in this study is the bilateral exchange rate of the domestic currency with the main trading partner: the DM for European countries and the US dollar for Japan and Australia, defined as the number of domestic currency units per unit of foreign currency. The choice of the exchange rate of the 'anchor' country and of the main trading partner (the DM for European countries and the US dollar for Japan and Australia) rather than the nominal effective exchange rate may look at first sight arbitrary, since the two could in principle move in opposite directions or by amounts which differ substantially. However, we have chosen the episodes in such a way that this is never the case. The episodes chosen are really 'turbulent' and entail large depreciations with respect to most currencies. A check for a number of episodes confirms that the bilateral rate chosen and the effective rate move in the same direction and by very similar amounts.[5] As bilateral rates tend to move more than effective rates, if a bias exists in the estimates of our exchange rate coefficients, it is towards zero, thus reinforcing the significance of our results. Another relevant point in this respect is that changes in the 'anchor' currency influence inflationary expectations at home more than the less visible effective rate and this may partly offset the previously mentioned bias.

Fourth, equation (3) predicts a positive sign for the degree of openness of the economy (OP), while Romer (1993) predicts a negative sign. However, there is no contradiction. What is implied in equation (3) is that, if the degree of openness is high, the effect on inflation is stronger when the country depreciates by a certain amount. Romer explains the average inflation rate over two decades or so, and his model suggests that the more open an economy is on average, the less it tends to depreciate and hence to inflate on average, because surprise inflation is less effective in influencing output.

[5] The following table compares changes in the nominal effective exchange rate and our bilateral exchange rate in a few episodes chosen at random.

Country	*Period*	*DM or \$* $(\bar{S}_B - \bar{S}_A)$	*Effective* $(\bar{S}_B - \bar{S}_A)$
Italy	91,3–93,2	4.79	4.32
Japan	84,2–86,3	–11.28	–7.14
Spain	82,4–84,3	–7.15	–5.05
Sweden	91,3–93,2	6.35	5.14

[5] As one can see, the differences are not very large.

Not all variables in equation (3) are defined in the same way: industrial production and foreign inflation are defined like the dependent variable. The rate of change of the exchange rate ($\dot{S}$) is a change with respect to the previous quarter and these quarterly changes are then averaged over each period. This implies that a 10 per cent devaluation at the beginning of quarter t and stability of the exchange rate thereafter would lead to a value of $\dot{S}_B$ of 2.5 per cent, very close to a depreciation of 2.5 per cent per quarter for four consecutive quarters.[6] Domestic demand and the real interest rate are also averaged.

In order for an episode to qualify for our sample, the exchange rate change over period B with respect to period A has to be at least 4 per cent in absolute value on an annual basis, i.e. the variable $\bar{S}_B - \bar{S}_A$ as defined above has to be at least 1 per cent per quarter, but is in general much higher.

Another equation which has been estimated has all the variables expressed as percentage changes in period B rather as accelerations with respect to period A:

$$\pi_B = \alpha_0 + \alpha_1 \bar{S}_B + \alpha_2 \bar{r}_B + \alpha_3 \dot{p}_{OIL,B} + \alpha_4 \bar{d}_B + \alpha_5 \dot{IP}_B + \alpha_6 \pi_{E,B} + \alpha_7 \dot{W}_B + \alpha_8 OP \qquad (4)$$

The episodes for the test of equation (4) are 77 rather than 80. The criteria used to choose the episodes are the same as for equation (3): the exchange rate change has to be 4 per cent for period B on an annual basis or more.

The next section contains the estimates of equations (3) and (4) using panel data.

III. Empirical Results

The data are quarterly and the sample period is 1966ql to 1993q2, but at least four observations are lost at the beginning because of the definitions of the variables as percentage changes with respect to the same quarter of the previous year. The criteria for choosing the 'episodes' to include in our sample were explained in Section II. The sample consists of 80 observations for the tests of equation (3) and 77 for the tests of equation (4).

Table 3 presents the tests of equation (3) for consumer prices. In regression (1) which does not include dummies, the real interest rate and the exchange rate have coefficients which have the right sign and are very significantly different from zero (as in De Grauwe and Tullio). In addition, the price of oil[7] turns out to be very significant, while our proxy for capacity utilization constructed using

[6] In the latter case, the depreciation would amount to 10.4 per cent.

[7] The price of oil defined as the annualized percentage change from quarter $t-4$ to quarter $t+3$ turns out to be more significant than defined as $\dot{p}_{OIL,B} - \dot{p}_{OIL,A}$. This is probably due to the fact that the former definition allows for long lags in the effect of the oil price on inflation; the oil price used in this paper is the spot price, for which the transmission to inflation takes much longer than for the actual import price. Unless otherwise indicated, the price of oil is defined therefore in the former way.

Table 3: Effects of Exchange Rate Changes on Consumer Price Inflation (Eqn 3 in the Text), Cross-country, 80 Observations

Regression Number	*(1)*		*(2)*	
Independent Variables	*Coefficient*		*Coefficient*	
Constant	–0.776	(–1.803)	–0.237	(–0.816)
$\bar{r}_B - \bar{r}_A$	–0.845	(–5.543)	–0.850	(–7.147)
$\bar{S}_B - \bar{S}_A$	0.175	(2.693)	0.107	(2.099)
$\dot{p}_{OIL,AB}$	0.023	(2.458)	0.027	(3.806)
$V\%(\bar{d}_B, \bar{d}_A)$	0.159	(1.669)	–	
DF73	–		–6.296	(–2.626)
DI74	–		–11.090	(–4.794)
DI75	–		10.747	(4.551)
DUK75	–		–8.618	(–3.715)
Adjusted R-squared	0.439		0.679	
S.E. of regression	3.005		2.271	
N-Jarque-Bera	7.281	(0.026)	0.466	(0.792)
F-Reset test(1)	0.002	(0.964)	(1.358)	(0.248)

Note: t-statistics or P-values in parenthesis.

only real consumption and investment with the exclusion of government expenditure, has the right sign and is almost significant at the 10 per cent level.

As to the size of the coefficients, they imply that an increase in the average interest rate of 100 basis points in period B with respect to period A leads to a fall in inflation of 0.85 percentage points; however, multicollinearity problems may bias this coefficient towards –1, especially for the consumer price equation, as explained in Section II. An average depreciation of 1 per cent per quarter in period B with respect to period A leads to a 0.2 percentage point higher inflation (0.1 in regression (2)): as by construction (by the way the episodes have been chosen) the devaluation is in general concentrated in the first quarter of period B, the coefficient implies also that a 4 per cent devaluation in quarter t followed by stability of the exchange rate in the remaining quarters of period B leads to a higher inflation of only 0.2 percentage points (a pass-through of 5 per cent). Thus, the magnitude of this coefficient is only 1/6 of that estimated by De Grauwe and Tullio (1994).

The difference is due, first, to the fact that in this study we allow for a lag of only slightly less than one year, as opposed to almost two in De Grauwe and

Tullio (1994), while the 1992–94 episode suggests lags may be even longer than two years. We allow for a lag which is on average even shorter than a year to the extent that $\dot{S}_n$ is influenced by construction also by depreciations which occur in quarters t+1 to t+3, and because the depreciation in quarter t does not necessarily occur on the first day of the quarter. Second, we use a bilateral exchange rate rather than the effective one, with the former being more volatile and covering a much smaller proportion of the country's foreign trade. Third, De Grauwe and Tullio (1994) use average inflation rates for each period, while here we use the cumulated inflation over each period. Finally, it should be recalled that even for the effective exchange rate the degree of long-run pass-through can be expected to be less than 100 per cent owing to the presence of non-traded goods.[8] We shall see below that for wholesale prices, for which the ratio of traded goods is much higher, we find a degree of pass-through which is 4–5 times higher than for consumer prices or in the order of 20–25 per cent.

The coefficient of the price of oil implies that a 10 per cent increase in the price of oil from quarter t–4 to quarter t+3 leads to a higher rate of inflation of about one-third of 1 per cent, while a 1 per cent increase in real domestic demand from period A to period B leads to a higher inflation of 0.16 percentage points.

Regression (1) presents problems of non-normality of the residuals (N-Jarque-Bera test). The equation passes the functional form misspecification test (F-Reset test). With the addition of four dummy variables, the problem with the residuals is eliminated (see regression (2)) and the significance of the coefficients of the real interest rate and the price of oil is greatly increased. Two of the dummies are connected with the first oil shock for France and Italy. The dummy variables are DF73 for France which assumes the value of 1 for the observation relating to the 1973–74 episode and zero otherwise, DI74 for Italy which assumes the value of 1 for the observation relating to the 1974–75 episode, and DI75 which assumes the value of 1 for the 1975–76 episode of the 1976 large devaluation of the lira. Finally DUK75 refers to the 1975–78 episode for the UK (appreciation of the pound, North Sea oil production and reduction of inflation not fully explained by the model).

Table 4 contains the estimates of equation (3) for wholesale prices. Now also industrial production as a proxy of capacity utilization and the state of the business cycle has a coefficient which is significantly different from zero at the 1 per cent level. Also domestic demand becomes significant at the 5 per cent level. The degree of pass-through of exchange rate changes is in the order of 20 per cent, about four times higher than for consumer prices, but still incomplete. Also the coefficient of real domestic demand is now much higher: 2–3 times higher than for consumer prices indicating that an increase of 1 per cent in real domestic demand leads to a higher inflation of 0.4–0.5 percentage points. The

[8] See the theoretical model of Section II.

Table 4: Effects of Exchange Rate Changes on Wholesale Price Inflation (Eqn 3 in the Text), Cross-country, 80 Observations

Regression Number	*(3)*		*(4)*	
Independent Variables	*Coefficient*		*Coefficient*	
Constant	–2.531	(–2.349)	–1.518	(–2.197)
$\bar{S}_B - \bar{S}_A$	–0.839	(–5.026)	0.738	(6.880)
$\dot{P}_{B} - \dot{P}_{A}$	0.312	(2.752)	0.338	(4.685)
$\dot{P}_{OIL,AB}$	0.076	(3.221)	0.087	(5.391)
$V\%(\bar{d}_B, \bar{d}_A)$	0.532	(2.190)	0.347	(2.230)
DF73	–	–	–39.816	(–7.824)
DI74	–	–	–31.046	(–6.159)
DUK73	–	–	17.918	(3.368)
Adjusted R-squared	0.375		0.756	
S.E. of regression	7.669		4.789	
N-Jarque-Bera	330.154	(0.000)	0.482	(0.786)
F-Reset test(1)	0.564	(0.455)	0.505	(0.480)

Note: t-statistics or P-values in parenthesis.

value of the coefficients of industrial production suggests a high sensitivity of wholesale price inflation to the business cycle (a 0.3–0.4 percentage points higher inflation for every 1 per cent increase in industrial production).

Thus both domestic demand and the business cycle are crucial in determining the degree of pass-through for wholesale prices and it seems that a devaluation may first influence industrial production and domestic demand before it is going to exert its full impact on wholesale prices. Thus aggregate demand policies in the years after the devaluation must be fundamental for the pass-through as they are also for the development of the current account and of the balance of payments (see the absorption approach of Alexander, 1951, and the monetary approach to the balance of payments and exchange rate determination (Frenkel and Johnson, 1976; Tullio, 1981). It may well be that the same holds for consumer prices, although with longer lags, and that we were unable to find very significant effects only because we chose a one-year lag rather than a two or three-year lag. After all, it is well known how important wholesale prices are for the development of consumer prices.

These findings suggest that the 1992–95 episode does not really constitute a break with the past, but it is explained by restrictive aggregate demand policies and high capacity utilization.

Also the size of the coefficient of the oil price is much higher than for consumer prices (about three times, implying that a 10 per cent increase in the price of oil leads to a higher inflation of 0.8 of a percentage point). The real interest rate is insignificantly different from zero for wholesale prices; this result may be caused by the much lower proportion of domestic goods in wholesale prices and may therefore be considered as the other side of the coin that sees wholesale prices as much more exposed to the development of the exchange rate, but it may also be due to lower multicollinearity between wholesale prices and real interest rates.

The residuals of regression (3) present problems of non-normality. Again, by adding a few dummies, the problems with the residuals are eliminated (see regression (4)). The dummies are three and they all relate to the episode of the first oil shock (for France, Italy and the UK). The first two are those already used in Table 3.

If we add foreign inflation to the explanatory variables of the regressions of Table 4, the coefficients of real domestic demand and of the price of oil lose their significance and the real interest rate now becomes significant at the margin. The tests are shown in Table 5. The coefficient of foreign inflation, which is proxied by inflation in Germany or in the US, depending on whether the country is

Table 5: Effects of Exchange Rate Changes on Wholesale Price Inflation (Eqn 3 in the Text), Cross-country, 80 Observations

Regression Number	*(5)*		*(6)*	
Independent Variables	*Coefficient*		*Coefficient*	
Constant	–0.265	(–0.345)	0.175	(0.328)
$\bar{r}_B - \bar{r}_A$	–0.457	(–1.324)	–0.624	(–2.658)
$\bar{s}_B - \bar{s}_A$	0.763	(5.313)	0.653	(6.437)
$\dot{p}_{B} - \dot{p}_{A}$	0.342	(3.311)	0.325	(4.608)
$\pi_{E,W,B} - \pi_{E,W,A}$	1.086	(6.748)	0.689	(5.991)
DF73	–	–	–29.265	(–6.179)
DI74	–	–	–25.255	(–5.380)
DI75			16.387	(3.528)
DUK73	–	–	21.688	(4.654)
Adjusted R-squared	0.532		0.792	
S.E. of regression	6.634		4.419	
N-Jarque-Bera	38.591	(0.000)	0.084	(0.959)
F-Reset test(1)	8.920	(0.004)	0.721	(0.399)

Note: *t*-statistics or P-values in parenthesis.

European or extra-European, has the expected value of 1 in the regression without dummies (regression (5)). This suggests that the foreign (global world) capacity utilization matters as much as, if not more than, the domestic one. The coefficient of the pass-through is slightly lower, that of industrial production slightly higher than before; the explanatory power of the regression without dummies is now much higher than before (adjusted R^2 =0.53). In the regression with the dummies the residuals are well behaved (regression (6)).

Tables 6 and 7 present the tests of equation (4) in which all variables are expressed as percentage changes rather than accelerations (and as a result the 'reference' period *A* is eliminated). The 'episodes' are now 77. The main differences with respect to the estimates of, e.g., (1) are: (a) wages are now extremely significant, (b) real domestic demand and the business cycle are now insignificant, (c) the degree of (short run) pass-through increases: for consumer prices from about 2.5–5 per cent to 5–7 per cent and for wholesale prices from about 16–21 per cent to about 20–25 per cent, (d) there is now some evidence that the degree of openness matters. Points (a) and (b) may be closely related because of the strong pro-cyclical behaviour of wages, as suggested by the Phillips curve.

Table 6: Effects of Exchange Rate Changes on Consumer Price Inflation (Eqn 4 in the Text), Cross-country, 77 Observations

Regression Number	*(7)*		*(8)*		*(9)*	
Independent Variables	*Coefficient*		*Coefficient*		*Coefficient*	
Constant	4.617	(3.331)	4.402	(3.484)	5.242	(6.138)
$\bar{r}_A$	–0.697	(–5.563)	–0.729	(–6.657)	–0.719	(–6.607)
$\bar{s}_A$	0.226	(2.117)	0.240	(2.478)	0.278	(3.135)
$\dot{p}_{OIL,AB}$	0.014	(1.367)	–	–	–	–
$\dot{w}_A$	0.286	(4.418)	0.394	(6.393)	0.399	(6.500)
OP	0.034	(1.268)	0.022	(0.904)		
DI70	–	–	–6.047	(–2.332)	–6.107	(–2.358)
DI73	–	–	–6.970	(–2.653)	–7.134	(–2.725)
DE77	–	–	–8.681	(–2.987)	–8.898	(–3.076)
Adjusted R-squared	0.770		0.809		0.810	
S.E. of regression	2.786		2.539		2.535	
N-Jarque-Bera	1.228	(0.541)	1.629	(0.443)	1.659	(0.436)
F-Reset test(1)	0.136	(0.714)	1.748	(0.191)	1.162	(0.285)

Note: *t*-statistics, or probability of rejection of the null hypothesis when the latter is true, in parenthesis.

Table 7: Effects of Exchange Rate Changes on Wholesale Price Inflation (Eqn 4 in the Text), Cross-country, 77 Observations

Regression Number / *Independent Variables*	*(10)* *Coefficient*		*(11)* *Coefficient*	
Constant	0.603	(0.355)	1.094	(0.756)
$\bar{r}_A$	–0.294	(–1.312)	–0.275	(–1.440)
$\bar{s}_A$	0.975	(5.482)	0.817	(5.306)
$\dot{p}_{OIL,AB}$	0.052	(2.198)	0.094	(4.305)
$\pi_{E,W}$	0.573	(3.252)	0.302	(1.911)
$\dot{w}_A$	0.279	(2.408)	0.325	(3.281)
DF74	–	–	–25.043	(–5.308)
Adjusted R-squared	0.698		0.782	
S.E. of regression	4.992		4.245	
N-Jarque-Bera	35.106	(0.000)	0.369	(0.832)
F-Reset test(1)	0.793	(0.376)	0.039	(0.844)

Note: *t*-statistics or P-values in parenthesis.

Thus it may be that in specification (2) the capacity utilization and the business cycle influence the degree of pass-through via wages as suggested in stage three of the theoretical model of Section II.

Starting with Table 6 (consumer prices), the coefficient of the degree of openness has the right sign, although it is not significantly different from zero at the 5 per cent level of significance. Nominal wages, monetary policy and the exchange rate are very significant. The adjusted R^2s are very high, considering that the dependent variable is expressed in percentage changes (0.77 in the regression without dummies). The residuals are well behaved in all regressions of the table.

Table 7 (wholesale prices) confirms the much higher pass-through for wholesale prices, the significance of wage behaviour (and hence indirectly of the cycle), the importance of oil prices and of foreign inflation. The inclusion of one dummy relating to one of the French episodes removes the problem of non-normality of the residuals.

IV. Summary and Conclusions

We started out in this article by asking two questions: (a) what is the pass-through of exchange rate depreciation to inflation?; and (b) have restrictive aggregate demand (and fiscal policy), low capacity utilization and the depressed business

cycle at home and abroad, and low wage growth something to do with the missing pass-through in a number of countries in 1992–95? For this purpose we developed a simple model of inflation in Section II, in which cost-push and demand-pull factors are assumed to influence inflation.

Our starting point has been the empirical research by De Grauwe and Tullio (1994) based on 23 episodes of devaluations for seven industrial countries from 1964 to 1986. By extending the number of episodes to 80 we wanted to check first whether domestic demand and capacity utilization matter and, second, whether their results on the pass-through and the role of monetary policy are robust.

Although within one year the degree of pass-through from exchange rate changes to inflation is quite low for consumer prices, we found a 20–25 per cent pass-through for wholesale prices. For both price indices the pass-through is very significant; in this respect the main result of De Grauwe and Tullio's paper is confirmed.[9]

We wanted to explain why, after the September 1992 foreign exchange crisis, inflation failed to accelerate in Italy and in other countries which devalued their currencies. We find strong effects of aggregate demand (fiscal and monetary) policies and of state of the business cycle, either directly[10] or indirectly through their effect on wages.[11] The oil price and foreign inflation are also very important and in one case also the degree of openness has some explanatory power.

The fact that the exchange rate of the lira was highly overvalued (by about 20 per cent) when the initial depreciation occurred in September 1992, entails that a part of the depreciation may be a lagged adjustment to the higher domestic inflation with respect to that of Germany in the years 1987–92 during which the nominal exchange rate was stable. To some extent, therefore, it is to be expected that after the devaluation inflation does not fully reflect exchange rate changes. But this fact alone cannot explain the missing pass-through: at least with reference to Italy, the message of this article is that a high interest rate policy, a restrictive fiscal policy, or a policy of wage moderation can keep inflation under control for many years and even reduce it, despite a 39 per cent depreciation of the exchange rate of the lira with respect to the DM.

[9] In a simulation performed with the Banca d'Italia econometric model Locarno and Rossi (1995) show that consumer price inflation in 1994 would have gone down to 0 per cent, had the exchange rate remained where it was in August 1992. Their results seem to be roughly consistent with ours.

[10] See the wholesale price equation when all variables are expressed in terms of accelerations with respect to the previous 'reference' period, eqn (3) of Section II.

[11] See the tests where all variables are expressed in percentage changes, eqn (4) of Section II.

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