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Exchange Rate Movements and Inflation Performance: The Case of Italy

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Abstract

This paper presents an empirical model to study the response of wages and prices to movements in the nominal exchange rate. A four-equation model is applied to Italian data to evaluate the response of tradeable goods prices, consumer prices, and wages following the lira's exit from the ERM in the fall of 1992. The model tracks reasonably well the inflation performance of tradeables, especially import prices. But it is argued that structural changes in the labor market contribute to an overprediction of price and wage inflation.

JEL Classification Numbers:

E31, F10, F31, F47

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Summary

The currencies of several countries in Europe depreciated sharply in the aftermath of the turmoil in the exchange rate mechanism (ERM) of the European Monetary System (EMS) in September 1992. This episode raised fears of increased inflationary pressures and a partial reversal of recent progress toward price stability. In the event, however, inflation remained at historically low levels and in several countries, like Italy, it even continued to decline gradually.

This paper investigates the recent inflation performance of Italy in the context of a four-equation econometric model that highlights the relationships between traded goods prices, the exchange rate, labor market structure, and the business cycle on the one hand, and domestic prices and wages on the other hand. The long-run estimates, derived from cointegrating relationships, are consistent with essentially full pass-through from exchange rates and foreign prices to domestic prices and wages. At the same time, dynamic estimates imply that inflation is significantly influenced by the business cycle, as proxied by estimated output and labor market gaps, and that there may be "pricing-to-market" behavior, which could attenuate the short-term effect of the exchange rate depreciation on imported goods prices in Italy.

Applied to the recent episode, these findings suggest that the pass-through of the exchange rate depreciation to the domestic prices of traded goods was broadly in line with historical experience, but that the business cycle downturn more than offset this effect, resulting in the observed inflation declines.

A key issue for policy is the effect on wage and price formation of the significant changes recently made to labor market institutions in Italy, particularly the abolition of wage indexation (*scala mobile*) and the establishment of a new wage bargaining framework. There is as yet insufficient experience with the new institutional arrangements to address this issue econometrically. Nevertheless, some aspects of the model suggest that a structural break may have occurred. In particular, the wage equation substantially overpredicts wages in 1993.

1. Introduction

The currencies of several countries in Europe depreciated sharply in the aftermath of the turmoil in the Exchange Rate Mechanism (ERM) of the European Monetary System (EMS) in 1992-93. This affected both currencies of countries that participated at the time in the ERM--notably Italy, Portugal, the United Kingdom, and Spain--but also some that had essentially tied their currencies to the system--especially Finland and Sweden. There was, naturally, considerable concern that the depreciations would lead to an acceleration of inflation pressures in these countries. By contrast, the actual experience has been better than anticipated, as inflation has generally remained at historically low levels in these countries, and even decelerated in several instances.

This paper attempts to shed some light on the inflation experience following the exchange market turbulences of the ERM, using as a case study the experience of the Italian lira. The exchange rate of the lira fell sharply following Italy's withdrawal in September 1992, after a period of a broadly stable nominal effective exchange rate since the mid-1980s (Chart 1). This depreciation raised considerable concern that domestic inflation would rise, and that some of the progress toward price stability that had been achieved during the lira's participation in the ERM would be reversed (for a discussion of the earlier disinflation experience in Italy, see Gressani, Guiso, and Visco (1988); IMF (1992); and Visco (1993)). Yet, during 1993 and the first half of 1994 wage growth in Italy remained subdued and the inflation rate continued to edge down (Chart 2).

One explanation for the moderation of domestic inflation in the face of this depreciation is that exporters to Italy absorbed the depreciation, at least partly, by lowering profit margins, measured in foreign currency, in order to protect market share. Because exporters will presumably not absorb losses indefinitely, this "pricing to market" behavior (Krugman, 1987) would imply only a delay of exchange rate passthrough, especially if the devaluation is not expected to be reversed. "Pricing to market" has been documented for specific markets by, for example, Gulde (1989), Kassa (1992), Feenstra, Gagnon, and Knetter (1993), Knetter (1993), and Caselli (1993).

However, an examination of aggregate import and export price data suggests that there was considerable passthrough of the devaluation into domestic traded goods prices in 1993. In the five quarters after the initial sharp depreciation of the lira (i.e., the period through the fourth quarter of 1993), import prices rose by about 16 percent, and export prices by 13 percent (Table 1). These increases appear to have been concentrated in late 1992 and early 1993, and to have slowed subsequently, before a renewed depreciation of the lira led to some flare-up in tradeable prices in the fourth quarter of 1993. The econometric estimates developed in section 2 and the simulations presented in section 3 confirm that the observed passthrough of the depreciation into traded goods prices was broadly in line

Table 1. Selected Inflation and Labor Cost Indicators, 1992-93

	1992				1993			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
	(Quarterly growth rate, in percent)							
Effective exchange rate	--	-0.5	-0.2	-11.1	-7.8	0.9	-1.6	-4.0
Import deflator	-0.3	1.2	-0.1	6.0	4.6	1.8	0.8	2.2
Export deflator	-0.2	0.9	-0.4	4.0	4.6	2.7	0.3	0.8
Consumer price index	1.5	1.2	0.8	1.2	1.2	1.2	0.9	1.0
Wages 1/	2.7	-0.2	2.8	0.2	0.2	1.3	0.6	1.7
Labor productivity 1/	0.7	1.0	--	0.8	0.2	1.3	1.0	1.8
	(Year-on-year growth rate, in percent)							
Effective exchange rate	-1.4	-0.3	-0.1	-11.7	-18.5	-17.4	-18.6	-12.1
Import deflator	-0.8	0.9	-0.9	6.8	12.1	12.7	13.7	9.7
Export deflator	0.8	1.5	-0.5	4.4	9.5	11.4	12.1	8.7
Consumer price index	5.6	5.4	5.0	4.7	4.4	4.4	4.6	4.4
Wages 1/	8.3	4.8	6.5	5.5	3.0	4.7	2.4	3.9
Labor productivity 1/	1.9	3.0	2.3	2.6	2.1	2.4	3.3	4.3

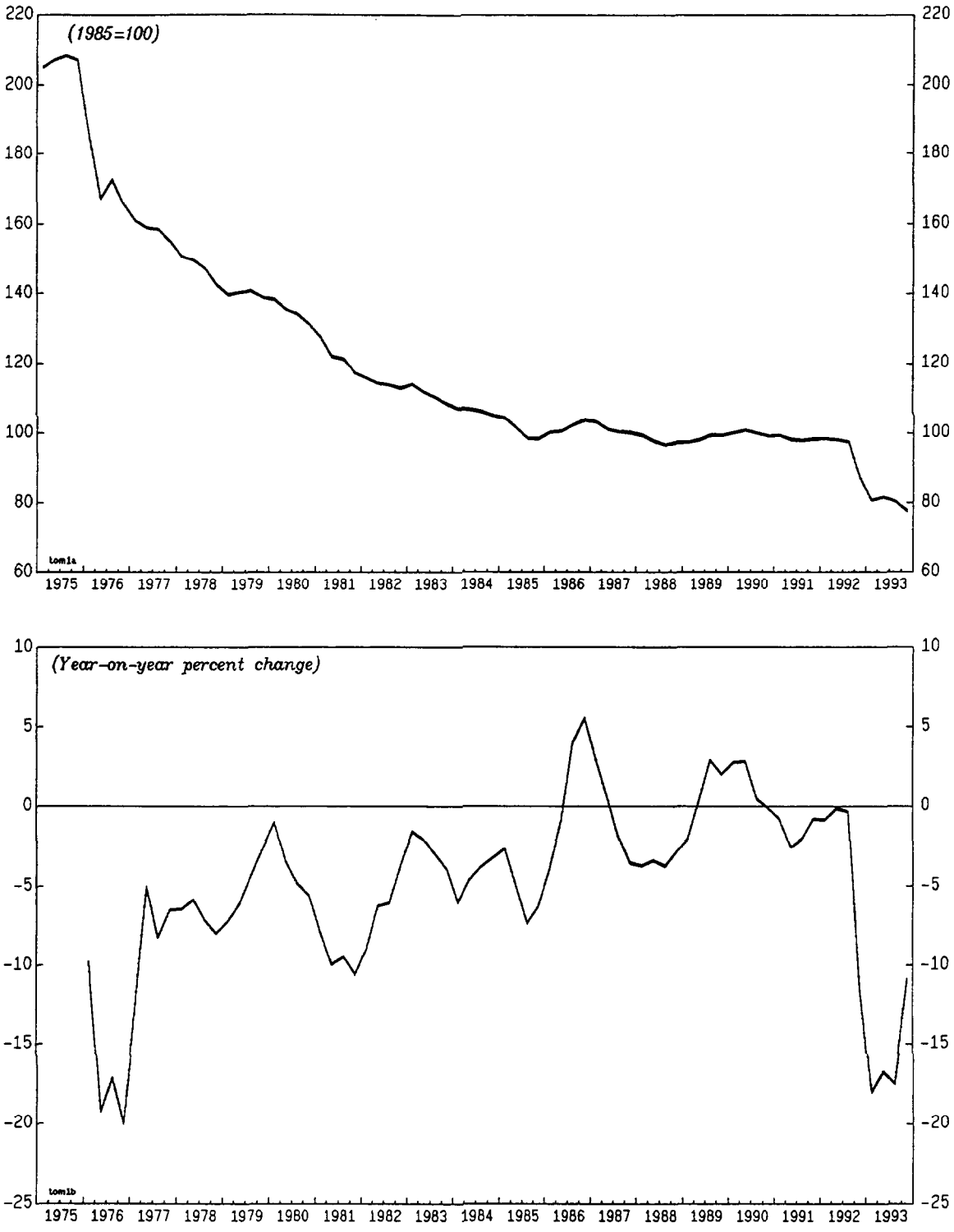
1/ Wages refer to labor cost per employee (measured in standard units of labor), including social security contributions. Wages and productivity refer to the private nonfarm business sector. For further details on the data sources, see Annex.

with historical experience, but is also consistent with transitory effects of "pricing to market".

The increase in import prices would be expected to push up domestic prices. A purely mechanical calculation of the effect of the 16 percent increase in import prices on the consumer price index--assuming imported goods are some 20 percent of the consumption bundle and there is no response of wage costs--would suggest an increase in the price level of about 3 1/4 percent. Feedback from wages and possible further increases in import prices would, of course, raise this figure. However, consumer price inflation declined by about half a percentage point from the fall of 1992 to the end of 1993.

Inflationary pressures appear to have been mitigated by two factors. The first is the sharp slowing of economic growth in 1992-93 and the corresponding increase in unemployment. The estimates reported below

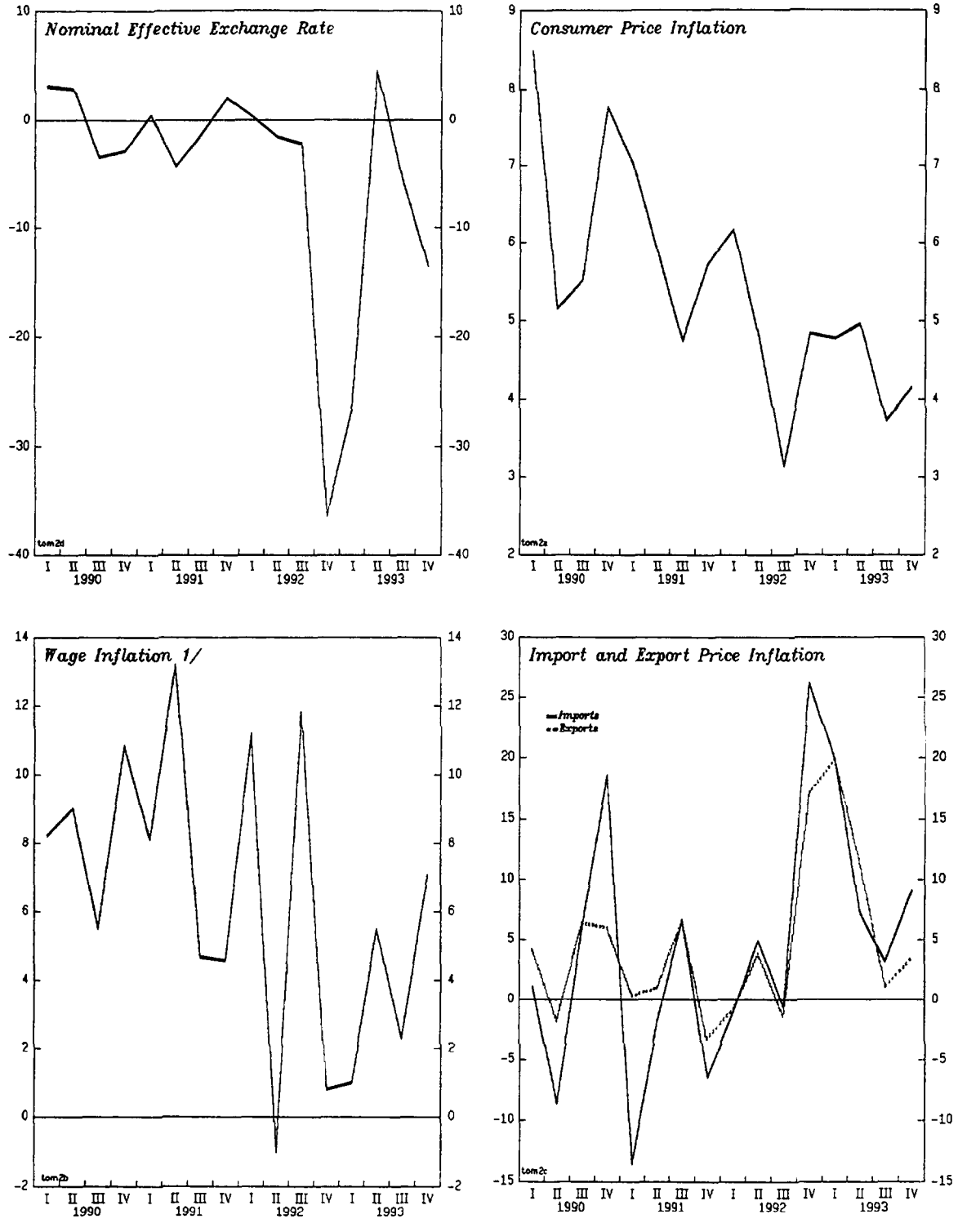
CHART 1
ITALY
Nominal Effective Exchange Rate



Source: IMF, International Financial Statistics.

CHART 2
ITALY

Exchange Rate Changes and Inflation
(Annualized quarterly percentage change)



Sources: ISTAT; and IMF, International Financial Statistics.

1/ Private nonfarm busines sector. Total compensation per standard unit of dependent labor.

suggests that the widening output and labor market gaps have held down consumer prices directly by limiting the recovery in profit margins, and also indirectly by reducing the growth of wages and import prices. Inflationary pressure would reoccur once the output and labor market gaps are closed. The second factor reducing inflationary pressures, and one that, for the time being, cannot be quantified econometrically, is the important structural changes that have occurred in Italy, particularly in the labor market (see also Demekas (1994)). The suspension and, ultimately, elimination of the backward-looking wage indexation scheme (*scala mobile*) resulted in considerably lower nominal wage increases than would have occurred had indexation remained in place. Moreover, since the social partners did not renegotiate wage settlements that had been agreed before the lira left the ERM and before the abolition of the *scala mobile*, nominal wage increases were unusually low during 1993. An important issue for the inflation outlook is how wages will behave under the new bargaining system, especially as the economy recovers and labor market conditions tighten.

This paper presents an econometric analysis of Italy's inflation performance since the lira left the ERM. Based on the experience of the previous fifteen years, it attempts in particular to shed light on whether a shift in behavior or in economic structure has occurred that would explain the favorable inflation trend in 1993 and 1994. The framework for the analysis is a four equation econometric model that relates traded goods prices, wages, and consumer prices to the exchange rate, world prices for tradables, domestic real-side developments in productivity and output, and structural features of the labor market. The estimation is designed to capture the major channels of exchange rate passthrough, and uses an error-correction specification to model longer-run relationships in the data while focusing on the short-term dynamic responses of prices and wages.

The next section develops the econometric model. Section 3 presents simulation results examining the period since the exit of the lira from the ERM. Section 4 draws conclusions.

2. Empirical estimates

The empirical model used in section 3 to quantify the influence of the exchange rate and other factors on domestic prices models four price variables (all variables are in logarithms, unless otherwise noted): the national accounts import and export deflators (denoted PM and PX), nonfarm business sector compensation, including employers' nonwage labor costs, measured in standard units of dependent labor (W, henceforth referred to as the wage), and the consumer price index (PC). The modelling strategy focuses on the role of the exchange rate and foreign price developments--which are treated as exogenous--in the determination of traded goods prices. Import prices feed into the wage-price bloc, which determines domestic inflation. All estimation was performed on quarterly data over the period 1977:Q1 to 1992:Q3, with the beginning of the sample dictated by data availability and the end of the sample chosen to avoid the effects of the

depreciation (which therefore represents an out-of-sample test of the model), as well as breaks in the official labor market data series.

It is important to bear in mind that the estimated empirical model is not a structural model, even though most features can be viewed as a reduced form of such models. Thus, underlying changes in the characteristics of the economy could lead to structural breaks in the estimated relationships. Still, even where such breaks occur it might be possible to assess at least their qualitative impact. Indeed, it will be argued below that this is possible for some of the recent changes in labor market regulations in Italy.

a. Modelling strategy

The import price is assumed to be determined by the nominal effective exchange rate (E), the foreign currency price of exports to Italy (PXF), the price of oil (POIL), and Italy's output gap (YGAP, which is not in logarithms). The price of exports to Italy is constructed as the national accounts export deflator of Italy's trading partners, weighted by the share of each country's imports in total Italian imports. 1/ Thus, the exchange rate plus the constructed foreign export price (in logs) approximates the price of imports to Italy, in lira, at the border. The output gap is the percentage difference between real value added in the nonfarm business sector and its trend. 2/ Excess supply in the goods market could reduce importers' mark-ups and therefore temporarily reduce the price of imports in the Italian market.

The export price is modeled as a function of the effective nominal exchange rate, the foreign currency price of Italy's imports in its trading partners (PMF), and domestic unit labor costs (ULC). By analogy with the price of foreign exports to Italy, PMF is the import deflator of Italy's trading partners, weighted by their share of exports in total Italian exports. PMF plus the exchange rate (in logs) approximates competitor prices faced by Italian exporters at the foreign border. ULC is the log of the wage minus the log of nonfarm business sector labor productivity (PROD), both based on standard units of dependent labor.

The wage equation relates labor compensation to consumer prices, nonfarm business sector labor productivity, the gap between the actual and trend rate of unemployment (UGAP, which is not in logarithms), nonwage labor

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1/ See the Annex for more details on data sources and variable definitions. Owing to data limitations, only 16 of Italy's largest industrial trading partners are included in PXF. In particular, oil exporters, except for the United Kingdom, are not included, which explains the importance of the oil price variable in the import price equation.

2/ Trend output, a proxy for potential output, was estimated by applying a Hodrick-Prescott filter to the real output series, with the "smoothing" parameter set at 1,600.

costs as a fraction of total labor costs (NWLC, not in logarithms), and the share of females in the labor force (FSL, not in logarithms). The unemployment gap is constructed as the difference between the actual and the trend of the unemployment rate in the north-center region of Italy. This specification is in line with substantial research, confirmed by preliminary investigations here, that show no impact on wage inflation from the unemployment rate in the south. It could reflect that the unemployed in the south are outsiders in the traditionally rather centralized wage bargaining process in Italy.

Consumer prices, measured by the consumer price index, can be thought of as being composed of two components. The domestic component is assumed to be governed by unit labor costs plus an implicit mark-up to cover capital and other costs. The model allows for the mark-up to be compressed by weak cyclical conditions, as captured by the output gap. There is also an import component of consumer prices, which is measured by the import price (the national accounts goods and services import deflator).

Preliminary testing using the augmented Dickey-Fuller statistic indicates that all series are nonstationary, except the gaps, which are stationary by construction. 1/ The tests also indicate the possibility that the domestic price variables--the consumer price index, wages, and unit labor costs--are integrated of order two. Traded goods prices and the exchange rate, on the other hand, appear to be integrated of order one. This difference in order of integration would imply that traded goods prices and the exchange rate are not cointegrated with domestic prices. In economic terms, this would mean, for example, that import prices have no long-run relationship to consumer prices. Because of the implausibility of this implication, the low power of these tests to reject near-nonstationary, and the observation that the levels of domestic and foreign price variables have still quite similar profiles over time, it is assumed that both domestic and external price variables are integrated of order one.

While the individual series are nonstationary, there may be a stationary linear combination of them, which is referred to as a cointegrating vector and is usually interpreted as a long-run relationship among the variables. The cointegrating vectors for the wage, export, and consumer price equations are estimated using the maximum likelihood technique of Johansen (1988) and Johansen and Juselius (1990). This technique provides a test for the existence of cointegrating vectors (there may be more than one) and estimates of the vectors. 2/ In the case of the

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1/ More precisely, the series are integrated of order one and, accordingly, need to be differenced once to create series of integration order zero. A series integrated of order zero has a mean and variance that are independent of time.

2/ In this paper, each of the cointegrating vectors are estimated separately. An issue for future research would be to estimate all four as a system.

import price equation, however, the Johansen technique could not identify satisfactory cointegrating vectors. The cointegrating relationship was instead estimated by the ordinary least squares procedure proposed by Engle and Granger (1987).

The equations of principal interest in the context of this study are those describing the short-run dynamics of the four prices. For each equation, the cointegrating vector is used to derive the error-correction term, which is imposed on dynamic regressions of stationary variables (the output and unemployment gaps and the first differences of the prices and productivity). A negative coefficient on the error-correction term implies that deviations from the long-run relationship will eventually be reversed and eliminated. All dynamic equations include, in principle, contemporaneous explanatory variables, but these are instrumented by lagged values of the regressors to account for possible simultaneity. 1/ Each dynamic equation was first estimated in an unrestricted form, and then statistically acceptable joint restrictions were imposed to achieve the final, parsimonious specifications reported below.

b. Price and wage determination

The estimated import price equation focuses on the response of import prices to foreign price developments, including those of industrial products and raw materials, and the exchange rate. The possibility that import prices might tend to respond differently to exchange rate movements than to movements of foreign export prices is investigated. A weaker response to exchange rate movements would be consistent with "pricing to market" behavior, discussed above. The model also allows the passthrough from foreign to domestic prices to depend on cyclical conditions, since a recession in Italy could be expected to compress profit margins and thereby reduce the passthrough of an exchange rate devaluation, at least temporarily.

As mentioned, the Engle-Granger two-step technique is used and, as a first step, the equation is estimated in levels and the residuals are tested for stationarity. The estimated level equation is: 2/

1/ There is evidence of simultaneity, in that the coefficients of the contemporaneous variables estimated by ordinary least squares are often larger and apparently more statistically significant than those estimated by instrumental variables.

2/ In all the reported regressions, t-values are presented in brackets below the coefficient estimates, the lag of a variable is shown in brackets following a variable name, F(*,*) is the F-statistic of the joint significance of the coefficients, and D.W. is the Durbin-Watson statistic of autocorrelation. In equation 1.1, these test statistics should be treated as indicative only, because the standard distributions are not valid in the presence of nonstationary regressors.

$$(1.1) \quad PM = -5.09 + 0.99\,(E + PXF) + 0.11\,POIL - 0.01\,YGAP(-4) + ECPM$$
$$\qquad\qquad (63.3)\quad (99.0)\qquad\qquad (16.0)\qquad (7.5)$$

$R^2 = 0.99 \quad F(3,59) = 4,853 \quad D.W. = 1.11$

$ADF(1) = 5.93\ (4.28)$

where import prices are regressed, using ordinary least squares, on the prices of exports to Italy converted into lira by the effective exchange rate, the world market price of oil in lira, and the output gap lagged four quarters. Although the gap is stationary, it was included to improve the estimates of the cointegrating vector ECPM, the residual of the first-stage regression, is the error-correction term to be incorporated in the second-stage, dynamic regression. T-statistics are in parentheses, although they are only indicative. The augmented Dickey-Fuller test (ADF, with its 5 percent critical value from MacKinnon (1990) in parentheses) indicates that ECPM is stationary and, therefore, that this equation represents a cointegrating vector.

The results in equation 1.1 indicate that import prices have an elasticity of close to 1 with respect to industrial partner country suppliers' prices. Including the oil price effect, the elasticity with respect to foreign prices is somewhat larger than unity. This could indicate some misspecification in the model, which does not incorporate the fairly substantial movements in non-oil material prices over the sample period. The results also indicate an effect of the cycle, as captured by the output gap, on import prices; a 1 percentage point increase in the output gap would tend to lower import prices temporarily by 1 percent.

The dynamic response of import prices to changes in each variable and to deviations in the long-run equilibrium relationship is estimated, using instrumental variables, as:

$$(1.2) \quad \Delta PM = 1.21\,\Delta PXF + 0.61\,\Delta PXF(-1) + 0.07\,\Delta POIL - 0.005\,YGAP(-2)$$
$$\qquad\qquad (4.96)\qquad (2.64)\qquad\qquad (5.59)\qquad (3.21)$$

$$\qquad\qquad - 0.44\,ECPM(-1)$$
$$\qquad\qquad (4.87)$$

$R^2 = 0.82 \quad F(4,57) = 63.6 \quad D.W. = 2.00$

$Chi\text{-}square(4) = 0.59\ (9.49),$

where the prefix Δ indicates the first difference (that is, because the variables are in logs, the growth rate). The Chi-square(4) statistic, which is the Lagrange multiplier test for serial correlation of the residuals, is well below its 5 percent critical value (in parentheses) indicating no serial correlation is present. ECPM, the residual from equation 1.1, has the appropriate sign. Moreover, the correction occurs quite rapidly, with over 40 percent of deviations from a long-run equilibrium being eliminated after one quarter.

Changes in the export prices of major partner countries (PXF) and the oil price add significantly to the short-run dynamics of import prices--even to the point of causing overshooting in the short run--whereas changes in the effective exchange rate were found to be statistically insignificant. This slower response of import prices in lira to exchange rate changes than to foreign price movements is consistent with short-run pricing to market behavior. Oil price changes translate relatively rapidly into domestic prices: comparing the coefficients in equations 1.1 and 1.2, about two-thirds of the long-run effect of a change in oil prices occurs within one quarter. The output gap reduces import price increases, as hypothesized.

Export prices are assumed to depend on the effective exchange rate, the price of imports in Italy's trading partners, and domestic unit labor costs. The Johansen maximum likelihood method was used to estimate the long-run cointegrating vector. The Johansen test statistics indicate that there is a unique cointegrating vector: 1/

(2.1) $PX = 0.58\ (E + PMF) + 0.49\ ULC + ECPX$

Tests for number (r) of cointegrating vectors:

a. Based on maximal eigenvalue of stochastic matrix

1/ The estimates are performed assuming a nonstochastic trend (although this turns out not to affect the results) and allowing for a vector autoregression of order 4 of the first differences of the variables. For this equation, and for the wage and price equations, the Johansen test statistics are read as follows. The tests for the number of cointegrating vectors are done sequentially. First, consider the null hypothesis that there are no cointegrating vectors ($r=0$) against the alternative that there is one vector ($r=1$). For equation (2.1), the test statistic is 36.4 which, given a critical value of 21, is sufficient to reject the null and conclude that there is at least one cointegrating vector. Second, consider the null that there is no more than one vector ($r\leq 1$) against the alternative of two vectors ($r=2$). In the table below, the test statistic of 5 is too low to reject the null, implying that there is at most one vector. For each equation, there are two sets of sequential tests based on different test statistics (eigenvalues and traces). For the equations estimated in this paper, the two statistics always point to the same conclusion.

Null	Alternative	Statistic	95% Critical Value
r = 0	r = 1	36.4	21.0
r ≤ 1	r = 2	5.0	14.1

b. Based on trace of stochastic matrix

Null	Alternative	Statistic	95% Critical Value
r = 0	r ≥ 1	42.8	29.7
r ≤ 1	r ≥ 2	6.3	15.4

Restriction (5 percent critical value = 3.8):

coefficients on E + PMF and ULC sum to 1: Chi-square(1) = 28.1.

Although the unrestricted estimate suggests that the exchange rate has a larger long-run impact than the foreign price, the restriction that they are equal cannot be rejected and has been imposed. The homogeneity restriction that the coefficients on the domestic nominal variables--the exchange rate and unit labor cost--sum to one is rejected, although sum of the unrestricted point estimates is close to one.

The dynamic specification is:

$$\underset{(2.2)}{\Delta PX} = \underset{(2.2)}{0.19}\ \Delta PX(-2) + \underset{(4.8)}{0.64}\ \Delta PMF + \underset{(2.8)}{0.45}\ \Delta ULC + \underset{(3.4)}{0.31}\ \Delta ULC(-1) - \underset{(4.0)}{0.37}\ ECPX(-1)$$

$R^2 = 0.79$ $F(5,56) = 42.84$

Chi-square(4) = 6.1 (9.5).

The coefficient on the error correction term has the appropriate sign, and the speed of adjustment to long-run equilibrium would appear to be roughly similar to that of the import price equation. The short-run response to the partner country import price is very strong, whereas the coefficient on the change in the exchange rate was not significantly different from zero. As in the case of the import equation, this result is consistent with pricing to market behavior. The coefficient on the first lag of the dependent variable was very small and insignificant, and was restricted to zero.

The wage equation relates labor compensation (including social security contributions by employers and employees) to consumer prices, labor productivity, employers' nonwage labor costs as a fraction of total labor

costs, and the labor force share of females, with the last two variables capturing structural aspects of the labor market. 1/ The estimated long-run cointegrating relationship is:

(3.1) $W = -11.9 + 1.00\ PC + 1.00\ PROD + 0.03\ NWLC - 0.03\ FSL + ECW$

Tests for number (r) of cointegrating vectors: 2/

a. Based on maximal eigenvalue of stochastic matrix

Null	Alternative	Statistic	95% Critical Value
$r = 0$	$r = 1$	48.1	18.6
$r \leq 1$	$r = 2$	15.2	14.1
$r \leq 2$	$r = 3$	3.9	3.8

b. Based on trace of stochastic matrix

Null	Alternative	Statistic	95% Critical Value
$r = 0$	$r \geq 1$	67.2	29.7
$r \leq 1$	$r \geq 2$	19.0	15.4
$r \leq 2$	$r = 3$	3.8	3.8

Restrictions (5 percent critical values: Chi-square(1) = 3.8, Chi-square(2) = 6.0):

NWLC coefficient zero: Chi-square(1) = 32.87
FSL coefficient zero: Chi-square(1) = 24.69
PC coefficient one: Chi-square(1) = 1.33
PROD coefficient one: Chi-square(1) = 1.10
PC and PROD coefficient one: Chi-square(2) = 2.24.

The unrestricted point estimates (not reported here) suggest that the response of wages to changes in consumer prices is somewhat stronger than to changes in productivity. But a unitary long-run elasticity for both variables cannot be rejected and is imposed. Neither of the structural labor market variables can be excluded statistically. Employers' nonwage labor costs tend to increase total compensation to some extent, indicating that the incidence of these costs is shared by employers and employees. The

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1/ The share of nonwage labor costs and the female share in the labor force are bounded between zero and 1 and, therefore, cannot truly be integrated of order 1. Nevertheless, they clearly behave like nonstationary variables over the sample period, and they were therefore included in the error-correction specification rather than the dynamic equation.

2/ The test statistics indicate that there could be as many as three cointegrating vectors, but only the vector associated with the largest eigenvalue, which is reported here, seemed economically meaningful.

share of female workers tends to lower compensation levels, which may reflect differences in productivity or wage discrimination.

The estimated short-run dynamic equation, which incorporates a Phillips curve relationship in the form of deviations of the unemployment rate from its trend, is:

$$\begin{aligned}(3.2)\quad \Delta W = {} & \underset{(12.3)}{0.89}\ \Delta PC + \underset{(2.0)}{0.52}\ \Delta PROD + \underset{(0.6)}{0.11}\ \Delta PROD(-1) + \underset{(2.1)}{0.35}\ \Delta PROD(-2) \\ & - \underset{(1.84)}{0.005}\ UGAP(-4) - \underset{(3.33)}{0.25}\ ECW(-1)\end{aligned}$$

$R^2 = 0.55$ $\quad F(5,56) = 13.9$ $\quad D.W. = 1.97$

Chi-square(4) = 2.20 (9.5).

Equation 3.2 indicates that one-fourth of a deviation of wages from their longer-run equilibrium is corrected within one quarter, and that about two-thirds would be corrected after a year. Price shocks are reflected in wages considerably faster--89 percent within one quarter. At least part of this differential reflects the widespread wage indexation that existed in Italy over most of the sample period. As this has recently been abolished, the dynamic response of wages is likely also to have changed. Wages also reflect productivity developments very quickly. However, the fact that over the sample period wage bargaining generally occurred only annually or in two-year cycles suggests that such a quick response is unlikely. Instead, the result may reflect to some extent the seasonal adjustment that was applied to the data. A 1 percentage point gap in the unemployment rate from its trend--an approximation for deviations from a "natural" rate--reduces wage growth by about 0.5 percentage points a quarter.

A key issue in wage determination in Italy is the effect of the suspension and abolition of the wage indexation scheme (*scala mobile*). This important structural change has occurred so recently, however, that a statistical test of its impact is impossible. The recent labor market picture has also been clouded by a revision to the labor market survey methodology, which resulted in a break in the unemployment rate and other series in the fourth quarter of 1992. The possible effects of the abolition of the *scala mobile* are addressed, although only in an ad hoc way, in the simulation exercises in section 3.

The consumer price index is modelled as a combination of domestic unit labor costs, import prices, and demand pressure, as measured by the output gap. The Johansen estimate of the cointegrating vector is:

(4.1) $PC = 0.18\ PM + 0.90\ ULC + ECPC$

Tests for number (r) of cointegrating vectors:

a. Based on maximal eigenvalue of stochastic matrix

Null	Alternative	Statistic	95% Critical Value
$r = 0$	$r = 1$	26.3	21.0
$r \leq 1$	$r = 2$	3.1	14.1

b. Based on trace of stochastic matrix

Null	Alternative	Statistic	95% Critical Value
$r = 0$	$r \geq 1$	31.6	29.7
$r \leq 1$	$r \geq 2$	5.3	15.4

Restriction (5 percent critical value = 3.8):

coefficients sum to 1: Chi-square(1) = 7.5.

The sum of the coefficients on PM and ULC exceeds unity somewhat, and the restriction that their sum equals unity is statistically rejected. The coefficient on import prices is close to estimates of the mechanical weight of imports in the consumer price index.

The dynamic equation includes the output gap to capture the compression of the mark-up during business cycle downturns: 1/

(4.2) $\Delta PC = \underset{(4.0)}{0.15}\ \Delta PM - \underset{(4.3)}{0.002}\ YGAP(-1) - \underset{(11.2)}{0.26}\ ECPC(-1)$

$R^2 = 0.85$ $F(3,58) = 108.7$ $DW = 1.86$

Chi-squared(4) = 7.8 (9.5).

1/ This equation also had a statistically significant constant term of 0.01, which has been implicitly buried in the error correction term since it implies that the long-run equilibrium will be slightly different from that implied by the error correction term from equation 4.1. A constant term in the dynamic equation is difficult to interpret economically although it may indicate that the effect of the gap on inflation is asymmetric. Note that the change in unit labor costs was not significant in the final specification.

These estimates imply that the response of prices to a deviation from a long-run equilibrium is similar to that of wages. About three-quarters of the estimated long-term response to a change in import prices occurs in the first quarter. A one percentage point output gap reduces inflation by 0.2 percentage points a quarter.

c. Model dynamics

To investigate the properties of the estimated model, four simulations of the system of equations 1.2, 2.2, 3.2, and 4.2, incorporating the long-term equations 1.1 through 4.1, were carried out, each subjecting the model to a different shock of an exogenous variable. The four shocks are a 10 percent depreciation of the nominal effective exchange rate, a 1 percent increase in the level of productivity, a 1 percentage point decrease in the labor market gap, and a 1 percentage point decrease in the output gap. The last two shocks tighten labor and output market conditions.

The results are summarized in Table 2. 1/ The depreciation is passed through to traded goods prices quickly, but the fully neutral effect on wages and prices occurs only slowly. The productivity shock has a proportional effect on wages, and little effect on the other prices, implying a rapid increase in the real wage. Tightening labor and output markets raises inflation, but the effect of a tighter labor market on prices begins only after four quarters, owing to the dynamic specification of the wage equation. In the model, the only domestic shock affecting import prices directly is an output shock. In reality, of course, the output and labor market gaps are correlated and a recovery would thus tend to raise all prices.

1/ The simulations were also performed with homogeneity imposed in the error-correction term of the consumer price equation, but the results were essentially unchanged from those reported in Table 2.

Table 2. Model Response to Exogenous Shocks

(Percent difference from baseline values)

Shock	Consumer Price		Wage		Import Price		Export Price	
	4 Qtrs.	8 Qtrs.	4 Qtrs.	8 Qtrs.	4 Qtrs.	8 Qtrs.	4 Qtrs.	8 Qtrs.
1.	1.6	3.2	1.5	3.0	8.1	9.7	5.8	7.9
2.	-0.1	--	1.0	1.0	--	--	--	--
3.	--	0.5	--	2.0	--	--	--	1.3
4.	0.8	2.1	0.8	2.0	0.8	2.4	0.5	1.3

Shock 1: 10 percent depreciation of the nominal effective exchange rate.
Shock 2: 1 percent increase in the level of productivity.
Shock 3: 1 percentage point decrease in the labor market gap (i.e., a tighter labor market).
Shock 4: 1 percentage point decrease in the output market gap (i.e., a tighter output market).

3. Inflation developments in 1992-93: simulation results

This section analyzes inflation developments during the period following the lira's exit from the ERM by simulating the dynamic four equation model derived in Section 2 (including the cointegrating equations) as a simultaneous system. The key issue is the explanation of the favorable inflation performance in Italy following the depreciation of the lira. The simulation compares the actual and predicted evolution of consumer prices, wages, and traded goods prices from late 1992, after the lira's exit from the ERM, to the fourth quarter of 1993, which was in most cases the last available data point. 1/

The nominal effective exchange rate of the lira depreciated by over 20 percent in the five quarters following the exit of the lira from the ERM in September 1992. At the same time, economic activity slowed

1/ For prices of externally traded goods, and also for the labor cost and productivity series, there is some concern about data quality for 1993. For traded goods prices, this relates in part to the changes in the collection of intra-EC trade data with the establishment of the European Union.

substantially, resulting in a sharp rise in unemployment and a widening of the gaps in goods and labor markets. In terms of the model, these two developments--the depreciation of the lira and the rise in market gaps--are exogenous and have opposite effects on inflation.

The observed behavior of import prices after the depreciation of the lira and through the end of 1993 was broadly in line with the model's prediction (Table 3). The deflator for imports of goods and services increased by over 16 percent, essentially identical to the model's simulated increase. There was, however, a difference in the timing of the increases: the model simulated a smaller increase than actually occurred in the quarter immediately following the lira's exit from the ERM, but by mid-1993 actual increases were below those simulated. The underprediction of actual import prices (and also export prices, see below) in the fourth quarter of 1992 may in part reflect the fact that the model is based on quarterly rather than monthly data; a substantial part of the depreciation occurred very late in the third quarter and early in the fourth quarter and, therefore, this is largely not reflected in the third quarter data. Since exchange rate movements begin to impact on import prices only with a one-quarter lag in the simulation exercise (see equation 1.2), the simulated import prices move still very little in the fourth quarter of 1992.

For export prices, the simulations yield somewhat longer cumulative increases as for import prices over the five quarters ending in end-1994. On the other hand, actual export prices rose at a somewhat slower pace. In particular, while the model tracks actual price movements fairly closely until about mid-1993, it fails to account adequately for the sharp slowdown in export price inflation in the second half of 1993; at this time, simulated export price increases are still around 3 1/2 percent per quarter while actual increases are only around 1/2 of 1 percent. The main reason for the overprediction of export prices in this period is a breakdown in the labor market relationship, discussed below. Since the simulation exercise uses the simulated rather than the actual--and in the event much lower--wage increase, it underpredicts the dampening effect from the observed slow growth in labor costs over this period. 1/

1/ This point can be illustrated by using actual rather than simulated wages in the export price equation. In this case, the actual level of export prices is very close to the simulated level at the end of 1994--within 1/2 of 1 percent.

Table 3. Actual Inflation Rates and Model Projections

	Import Prices		Export Prices		Wages 1 /		Consumer Prices	
	Actual	Proj.	Actual	Proj.	Actual	Proj.	Actual	Proj.
	(Quarterly growth rates, in percent)							
1992 Q4	6.0	0.3	4.0	2.2	0.2	1.5	1.2	0.9
1993 Q1	4.6	5.9	4.6	3.3	0.2	2.0	1.2	1.6
Q2	1.8	6.0	2.7	5.0	1.3	2.8	1.2	1.6
Q3	0.8	2.0	0.3	3.4	0.6	2.3	0.9	1.2
Q4	2.2	1.3	0.8	3.5	1.7	3.2	1.0	1.0
	(Year-on-year growth rates, in percent)							
1992 Q4	6.8	1.1	4.4	2.6	5.5	6.9	4.7	4.4
1993 Q1	12.1	7.4	9.5	6.3	3.0	6.2	4.4	4.5
Q2	12.7	12.4	11.4	10.6	4.7	9.4	4.4	5.0
Q3	13.7	14.8	12.1	14.6	2.4	9.9	4.6	5.4
Q4	9.7	16.0	8.7	16.1	3.9	10.8	4.4	5.5
Total increase 1992Q3-93Q4	16.2	16.3	13.1	18.7	4.1	12.4	5.7	6.5

1/ Compensation per employee in the private nonfarm business sector.

The empirical model predicts a wage increase of 10 percent during the year following the lira's exit from the ERM and a further 3 1/4 percent increase in the fourth quarter of 1993. The cumulative increase over these five quarters is much higher, indeed three-times higher, than the observed increase of 4.1 percent. Underlying the exceptional behavior, by historical standards, of actual labor compensation per employee was a decline in dependent employment in the private nonfarm business sector of around 4 1/4 percent that was accompanied by a small decline of the wage bill in this sector. By contrast, the simulations envisage fairly strong upward pressure on wages during this period, mainly on account of consumer price inflation, which is influenced by the depreciation, and the observed increase in productivity, which is exogenous to the model.

The overprediction of wages is to some extent expected and could indicate that the end of the *scala mobile* changed structural labor market relationships. In particular, backward-looking wage indexation was replaced

by a more forward-looking bargaining system. Moreover, it is estimated that the suspension of the indexation-related wage increase in May 1993 lowered wage payments by almost 2 percent. With few wage contracts renewed in 1993, actual wages fully reflected neither the rise in consumer prices nor, especially, the apparently fast growth in labor productivity measured during this period (around 5 percent). None of these changed structural factors are captured in the model.

In the five quarters following the exchange market turbulence in September 1992, the recorded cumulative 5.7 percent increase in consumer prices was about 3/4 of 1 percentage point lower than the increase implied by the model. This overprediction is small in view of the fact that results are based on a considerably higher growth in wages forecasted by the model, while import prices are projected quite precisely. Indeed, judged against the low growth in actual wages, the observed rise in consumer prices was considerably higher than the consumer price equation would have predicted on the basis of actual wage and productivity developments. This could suggest that there was some inflation inertia present in Italy beyond the prediction of the model.

4. Conclusions

The empirical model of inflation for Italy, emphasizes the mechanisms of inflation passthrough from changes in the exchange rate to traded goods prices and domestic price and wage inflation. The estimated model coefficients imply nearly neutral behavior in the long run, although strict neutrality was not imposed. However, the estimated parameters also imply that business cycle conditions, as captured by output and labor market gaps, have a significant short-term effect on inflation passthrough. There is weak and somewhat indirect support for the hypothesis that importers "price to market", in that exchange rate movements are not fully translated into domestic traded goods prices, as measured by national accounts import and export deflators, in the short term.

The short-run response of traded goods prices following the lira's exit from the ERM in September 1992 was broadly in line with the predictions of the model, especially for import prices. By the end of 1993, the prices of imports had risen essentially the same as the model predicted. However, they had not risen by the full long-run effect predicted by the model, implying that some inflationary pressure from the depreciation in 1992 and 1993 remained in the pipeline for 1994. This also applies to export prices, where the model overpredicted the observed price increases due to an overprediction of unit labor costs (see below).

The rise in import prices puts upward pressure on domestic prices. In the first instance, this occurs through the mechanical effect of raising the lira value of imported goods that are represented in the consumer price index. This effect is then amplified in the model as wages rise in response to prices, setting off a wage-price spiral. In the event, the short-run response of consumer prices, conformed reasonably closely to the predictions

of the model. The significant degree of output slack in late 1992 and in 1993 attenuated the effect of the depreciation on consumer prices, resulting in a reduction of inflation between 1992 and 1994.

By contrast, the pattern of wage growth in 1993 is not well explained by the model. The model predicts that the slack in the labor market should have been more than offset by the measured increase in productivity--due to substantial reductions in employment--so that wage growth would have accelerated in 1993. In fact, wage growth was contained during 1993 and below the consumer price inflation rate. This apparently unusual behavior can be traced, at least in part, to three important factors. First, the *scala mobile*, which provided for automatic wage indexation to price developments, had been suspended and was eventually abolished in 1993. Second, wage negotiations in 1992 had been concluded on the assumption that the lira would remain in the ERM, and were not reopened. Third, with multiyear contracts in place, new general wage agreements were also not negotiated for 1993. In all, this resulted in exceptionally low wage increases.

Data Sources and Definitions

The data source for all domestic variables is the Italian statistical institute (ISTAT). Foreign price variables are based on the OECD's Analytical Data Base, except for the world market price of oil and exchange rate data which are from the IMF's International Financial Statistics. All data are at a quarterly frequency and seasonally adjusted.

Wage, productivity, and output series refer to the private nonfarm business sector, defined as the total economy excluding agriculture and non-market services. Wages are defined as total compensation per employee, including employer and employee social security contributions. The number of employees, used to calculate the wage and productivity series, refers to standardized units of dependent labor. Unit labor costs are the ratio of total compensation and value added in the private nonfarm business sector.

The output gap is the percentage difference between actual and potential value added at market prices in the private nonfarm business sector; potential value added is approximated by applying a Hodrick-Prescott filter (smoothing factor: 1,600) to the actual output series. The unemployment gap is the difference between the actual and the trend unemployment rate; the trend unemployment rate, a proxy for the natural rate, is calculated by applying the Hodrick-Prescott filter (smoothing factor: 20,000) to the unemployment rate series.

All variables are in logs, except when indicated otherwise. The variable symbols in the text are defined as follows:

E Nominal effective exchange rate 1/
FSL Female share of the labor force, in percent
NWLC Nonwage labor cost (employers' social security contributions), in percent of total compensation in the private nonfarm business sector
PC Consumer price index
PM National accounts deflator for imports, goods and services
PMF Foreign partner country import deflators, in foreign currencies 1/
POIL World market price for crude oil price, converted into lira
PROD Value added per standardized unit of labor, private nonfarm business sector
PX National accounts deflator for exports, goods and services
PXF Foreign partner country export deflators, in foreign currencies 1/
UGAP Unemployment gap in the north-center, in percent
ULC Unit labor cost, private nonfarm business sector
YGAP Output gap, private nonfarm business sector, in percent
W Compensation (wages plus social security contributions of employers and employees) per standardized unit of labor.

1/ Based on a trade weighted average for Italy's 16 largest industrial trading partners.

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