Growth, inflation and the exchange rate regime

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Received 6 April 1996; accepted 11 July 1996

Abstract

According to the Balassa–Samuelson effect, growth and inflation are positively correlated in economies with pegged currencies. This paper shows that the costs of inflation on long-term growth are underestimated in samples that include countries and periods with fixed exchange rate regimes.

Keywords: Inflation; Growth; Exchange rate

JEL classification: F43; O49

1. Introduction

In spite of the existence of several theoretical models that predict negative effects of inflation on long-term growth,\textsuperscript{1} the econometric evidence is far from conclusive.\textsuperscript{2} Even among those who find significant negative coefficients of inflation in growth equations, the estimated effects are fairly small. As an example, in a recent study, Barro (1995) concludes that "... an increase in average inflation of 10 percentage points per year reduces the growth rate of real per capita GDP by 0.2–0.3 percentage points per year".\textsuperscript{3} In this paper we argue that many of these empirical studies are likely to underestimate the costs of inflation if they do not control for the influence of different exchange rate regimes operating during the sample period.

The argument for this downward bias runs as follows. Suppose that there is a genuine negative effect of inflation on growth and that we try to estimate it with a panel of countries

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\textsuperscript{1} See, inter alia, De Gregorio (1993) and Roubini and Sala-i-Martin (1995).

\textsuperscript{2} See Levine and Renelt (1992) and Fischer (1993).

\textsuperscript{3} Furthermore, this effect is only significant for the group of countries whose average inflation rate lies above 15\% per year.
over time periods that are dominated by fixed or pegged exchange rate regimes. According to the well-known Balassa–Samuelson effect (see Balassa, 1964, and Samuelson, 1964), a country with high productivity growth will experience a real appreciation in its currency which, under a fixed exchange rate regime, will be achieved through higher inflation. This will induce a positive correlation between both variables which, in turn, will bias downwards the estimated effect of inflation on growth in all those empirical studies that do not control for the exchange rate regime in operation. In this paper we try to assess this possible bias by exploiting the variability of exchange rate regimes both across a sample of OECD countries and across time.

2. The Balassa–Samuelson effect

The theoretical underpinning of the Balassa–Samuelson effect can be summarized as follows. Let us assume a simple Ricardian model with two countries which use labour to produce two types of goods: a traded good \( t \) and a non-traded good \( n \). Under perfect competition and a constant returns to scale (CRS) technology, the following equilibrium conditions hold:

\[
P_t = eP^*_t, \tag{1}
\]

\[
l_tP_t = w = l_nP_n, \tag{2a}
\]

\[
l^*_tP^*_t = w^* = l^*_nP^*_n. \tag{2b}
\]

The symbols \( P, e, w \) and \( l \) denote the price level, the nominal exchange rate, the wage rate and the marginal product of labour, respectively. In turn, variables without superscript denote domestic variables, and variables with an asterisk denote foreign variables. Eq. (1) describes the law of one price for traded goods. Eqs. 2(a) and 2(b) state that the wage rate \( w \) is the same in both the tradeable and the non-tradeable sectors. Thus, labor is perfectly mobile within each country, but not across countries.

Defining the domestic \( (P) \) and foreign \( (P^*) \) price levels as weighted geometric averages of prices in both sectors, i.e.

\[
P = P^iP^j, \tag{3a}
\]

\[
P^* = P^*_iP^*_j, \tag{3b}
\]

where \( i \) (\( j \)) represent the proportion of non-tradeables in total domestic (foreign) production, the real exchange rate defined, in turn, as \( \theta = P/eP^* \), can be rewritten, using (1)–(3) as

\[
\theta = (l_t/l_n)^i/(l^*_t/l^*_n)^j. \tag{4}
\]

Eq. (4) shows that a country experiences a real appreciation if productivity in the tradeables sector rises relatively fast. Thus, there is a positive link between growth and the real exchange rate. If exchange rates are flexible, then a real appreciation can be brought about by exchange rate changes. But in a fixed exchange rate system a real appreciation corresponds to a higher inflation rate in the appreciating country.
3. The empirical analysis

As mentioned earlier, the finding of a negative relationship between inflation and growth is quite remarkable given the high weight of fixed exchange rates in the past. The period 1960–1973 was characterized by fixed exchange rates for most industrialized countries. During the 1960s nearly all of them had pegged their currencies in the Bretton Woods system. After the breakdown of Bretton Woods, there were a number of attempts by European countries to peg their currencies, which proved to be at least temporarily successful. The estimated effect of inflation on growth can be expected to be stronger for a sample corresponding to countries and periods with floating currencies.

To avoid the risk of ad-hoc specifications with omitted variables, the neoclassical growth model augmented with human capital (Mankiw et al., 1992) is taken as a frame of reference. According to this model, per capita growth between two periods of time \((T\text{ and } T + r)\) can be written as

\[
y_{T+r} - y_T = \phi r + (1 - e^{-\lambda r})[\Omega + \mu r + \phi T + \beta^{-1}(\alpha s^*_k + \gamma s^*_h - (\alpha + \gamma) s^*_n) - y_T],
\]

where \(y\) is the log of real income per capita, \(s^*_k\) is the log of investment in physical capital as a share of GDP, \(s^*_h\) is the log of the share of investment in human capital, \(s^*_n\) is the log of the growth rate of population \((\delta)\) augmented by \(\phi\) and the depreciation rate for physical and human capital \((\delta)\) and \(\phi\) is the exogenous rate of technological progress. The shares of labour, physical and human capital in output \((\beta, \alpha, \gamma)\) add up to one, under the assumption of CRS. \(\Omega\) is a constant combining different parameters of the model and \(\lambda\) is the rate of convergence towards the long-run growth path. We have assumed that inflation \((\pi)\) affects the level of total factor productivity and, hence, growth.

We have estimated Eq. (5) for a sample of OECD countries during 1961–1992, with a pooling of four years averages of the variables to take advantage of the time-series dimension of the information set. The main results are presented in Table 1. The first column presents the estimation of Eq. (5) with the pooled data for the whole sample. The inflation coefficient indicates that an increase in average inflation of ten percentage points per year reduces per capita growth by 0.7 percentage points per year.

To investigate the presence of the Balassa-Samuelson bias the following results are presented. In column (2) the model is estimated for the whole sample including a dummy which takes the value 1 for some periods of fixed exchange rates for each country; similarly, in column (3) the dummy takes the value 1 for observations in a floating exchange rate regime. Alternatively, in columns (4) and (5) the model is estimated for different subsamples, corresponding to different exchange rates regimes.

As expected, the negative impact of inflation on growth is higher for countries under the floating exchange rate regimes, although the size and the statistical significance of the estimated effect varies across the different specifications. In the most restrictive case, in which we only allow for differences in the inflation coefficient in an otherwise homogeneous model for the countries in the sample, the results are less clear-cut. Although the coefficient of the

\[\text{Footnote: For a description of the data set, see Andrés et al. (1996).}\]
Table 1
Growth convergence equations augmented with inflation

<table>
<thead>
<tr>
<th></th>
<th>Whole sample (1)</th>
<th>Whole sample (2)</th>
<th>Whole sample (3)</th>
<th>Fixed (ERM+ Bretton Woods) (4)</th>
<th>Floating (IMF) (5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\alpha$</td>
<td>0.34</td>
<td>0.35</td>
<td>0.34</td>
<td>0.35</td>
<td>0.11</td>
</tr>
<tr>
<td></td>
<td>(5.04)</td>
<td>(5.19)</td>
<td>(5.04)</td>
<td>(3.90)</td>
<td>(0.65)</td>
</tr>
<tr>
<td>$\gamma$</td>
<td>0.16</td>
<td>0.16</td>
<td>0.16</td>
<td>0.16</td>
<td>0.24</td>
</tr>
<tr>
<td></td>
<td>(3.02)</td>
<td>(2.99)</td>
<td>(3.02)</td>
<td>(2.30)</td>
<td>(1.08)</td>
</tr>
<tr>
<td>$\phi$</td>
<td>-0.04</td>
<td>-0.03</td>
<td>-0.04</td>
<td>-0.01</td>
<td>-0.08</td>
</tr>
<tr>
<td></td>
<td>(1.70)</td>
<td>(1.24)</td>
<td>(1.69)</td>
<td>(0.44)</td>
<td>(1.16)</td>
</tr>
<tr>
<td>$\mu$</td>
<td>-0.020</td>
<td>-0.019</td>
<td>-0.020</td>
<td>-0.015</td>
<td>-0.048</td>
</tr>
<tr>
<td></td>
<td>(5.14)</td>
<td>(4.16)</td>
<td>(5.02)</td>
<td>(0.93)</td>
<td>(2.31)</td>
</tr>
<tr>
<td>$\mu^*D_1$</td>
<td></td>
<td>0.023</td>
<td>-0.008</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(2.23)</td>
<td>(0.77)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$R^2$</td>
<td>0.52</td>
<td>0.54</td>
<td>0.53</td>
<td>0.57</td>
<td>0.31</td>
</tr>
<tr>
<td>$\sigma$</td>
<td>0.049</td>
<td>0.04</td>
<td>0.049</td>
<td>0.046</td>
<td>0.049</td>
</tr>
</tbody>
</table>

Notes: Estimation method: OLS; $t$-ratios appear in parentheses.
(2) $D_1=1$ for observations corresponding to countries and periods under the Exchange Rate Mechanism (ERM) of the European Monetary System (EMS) and for observations corresponding to Bretton Woods period, $D_1=0$ otherwise.
(3) $D_2=1$ for observations corresponding to a floating exchange rate regime according to International Monetary Fund (IMF) classification, $D_2=0$ otherwise.
(4) Observations corresponding to countries and periods under the ERM of the EMS (high exchange rate volatility periods are excluded) and observations corresponding to Bretton Woods period.
(5) Observations corresponding to a floating exchange rate regime according to IMF classification.

dummy is negative in the floating exchange regime (column (3)) and positive in the fixed regime (column (2)), it is only significant in column (2). However, imposing the same model to different samples can be very restrictive. In columns (4) and (5) the model is estimated for the homogeneous subsamples, according to their exchange rate system. The estimated coefficients now change dramatically as we move from a floating to a fixed exchange rate system. In column (5), the estimated $\mu$ is now negative and twice as big as the one in column (1). It can be argued, though, that the equation in column (5) shows some signs of misspecification or, at least, that the convergence model might be inappropriate. However, eliminating the floating exchange rate countries from the sample confirms the importance of the bias generated by the Balassa–Samuelson effect. In column (4), the augmented growth model seems to perform rather well and the estimated cost of inflation is not significant.
These results give some support to the conclusion that the exchange rate regime matters when measuring the costs of inflation in terms of long-term growth.

Acknowledgements

We thank Francisco de Castro for his excellent research assistance. We also thank Juan Ayuso, Steve Hay, Albert Marcet, José Viñals and especially Juanjo Dolado for valuable comments on a previous draft. J. Andrós acknowledges financial support by DGICYT grant PB92-1036.

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