The Determinants of the Inflation Rate in Transition Countries — A Panel Data Analysis —

Takeshi Inoue

Abstract: The theoretical literature points out that inflation targeting and the exchange rate peg have the advantage of lowering the inflation rate. Controlling for the other relevant variables, this paper estimates the effects of these policies on the inflation rate in 20 transition countries during 1995-2003 by using regressions on panel data. The main finding is that inflation targeting and the exchange rate peg appear to have been effective in lowering inflation rate even in transition countries.

Keywords: inflation rate, panel data, transition economies

Introduction

In the first half of the 1990s, the transition economies in Central and Eastern Europe (CEE) and the former Soviet Union (FSU) were commonly faced with high inflation and output decline. Against these backgrounds, most countries in CEE opted for the exchange rate peg as a nominal anchor because an external anchor was regarded as the most effective strategy to stabilize the economy (Nerlich, 2002, p.2). In fact, these countries had successfully reversed macroeconomic trends, and achieved inflation reduction as well as economic growth by 1994. However, inflation differentials with the main neighboring trading partners still persisted, and caused the loss of external competitiveness under the fixed exchange rate regime. Moreover, large capital inflows made it difficult for the country with a pegged exchange rate to pursue a further disinflation process. Therefore some countries in CEE continuously modified their exchange rate regimes to allow for more flexibility and the Czech Republic, Poland and Hungary have eventually adopted “inflation targeting”, while the Baltic States have maintained the fixed exchange rate regime.

Since the primary objective of inflation targeting and the exchange rate peg is to reduce the inflation rate, these policy frameworks are expected to play an important role for the above countries because the achievement of a low one-digit inflation rate is one of the convergence criteria for the preparatory phase of the introduction of the euro.

In this paper I consider the effectiveness of inflation targeting and the pegged exchange rate on disinflation from the empirical viewpoint. The structure of the paper is the following. Chapter 1 outlines earlier studies of the inflation rate in transition countries. In Chapter 2, using a panel of 20 transition economies, I analyze to what extent the policy frameworks such as inflation targeting and the exchange rate peg have been correlated with lower inflation in transition countries, which has been given little attention in the literature thus far. The final chapter contains concluding remarks.

1 Review of Empirical Literature

As statistical data have accumulated, more quantitative analyses of the experience in the transition economies have become available since the
middle of the 1990s. Especially, there is substantial empirical literature that explains the change in price level in CEE and the FSU, using regressions on cross-section and panel data. In this chapter, I summarize these empirical works and review the relative contributions of the main determinants to the inflation rate in transition countries. The factors I focus on are economic liberalization, initial conditions, central bank independence and fiscal balance.

1. 1 Economic Liberalization

de Melo, Denizer and Gelb (1996) first develop the index to measure the level of economic liberalization in transition countries. This is called the liberalization index (LI), and its cumulative one (CLI) has widely been applied to explain the inflation rate by the empirical literature \(^1\). As summarized in Table 1 and 2, every study except Cukierman, Miller and Nayapti (2000) confirm that inflation is significantly lower the higher is CLI.

LI is a weighted average of the degree of liberalization in internal market, external market and private sector entry. Taking these sub-components into account, it is pointed out that domestic liberalization produces sizable temporary non-monetary jumps in inflation as prices of domestic goods are allowed to adjust towards market values, whereas the other economic reforms lower inflation because factors such as the openness to external trade and the freedom of entry in domestic markets tend to enhance price competition and efficiency gain (Hernandez-Cata, 1999, p.7 and Cukierman et al., 2000, p.18).

1. 2 Initial Conditions

Concerning initial conditions and the inflation rate, the empirical literature shows a variety of relationships between them, since different variables are used as initial conditions.

Krueger and Ciolko (1998) include the regional dummy variables as the measure of initial condition, and find that the countries in the FSU have the higher inflation rate than the other regions. Krueger et al. (1998) also regress inflation on initial conditions represented by the share of exports in GDP for the non-FSU countries and the level of per capita GNP in the late of the 1980s, controlling for CLI and the regional tension dummy, and point out that export share is significantly negative, but per capita GNP is insignificant.

de Melo et al. (1997) develop the cluster variables called PRIN1 and PRIN2 to measure the distortions of macro-economy and structure respectively, and find that the relationship between macroeconomic distortion and inflation is positive and statistically significant, while structural distortion has a positive, but insignificant impact on the inflation rate. Since the cluster PRIN1 and PRIN2 include intra trade share in GDP and per capita income respectively, it follows that de Melo et al. (1997) partly correspond to the Krueger et al. (1998) result.

1. 3 Central Bank Independence

Various authors have so far constructed the index for central bank independence (CBI) from central bank charters, legislation and turnover rates of central bank governors, and have examined the relationship with economic performance across countries. For example, Cukierman et al. (2000) construct CBI for the new central banks in 26 former planned countries and confirm that the higher independence is associated with lower inflation as is the case in developed countries, given the higher levels of cumulative liberalization measured by CLI.

Loungani and Sheets (1997) also estimate the relationship between central bank independence
and inflation in twelve transition countries by using a different index from that of Cukierman et al., and find the significantly negative correlation between political independence of central bank and inflation, which is however in contrast with the regression evidence for 17 industrial countries by Debelle and Fischer (1994).

1. 4 Fiscal Balance

The literature commonly confirms that inflation is lower in the countries that had the lower fiscal deficits. In particular, Fischer, Sahay and Vegh (1996) argue that the smaller fiscal deficits under the fixed exchange rate is especially important in reducing inflation.

2 The Effects of Policy Frameworks on Disinflation

As summarized in the previous chapter, the empirical literature addressing the determinants of the inflation rate in transition countries has primarily concentrated on the effects of economic liberalization, central bank independence, initial conditions and macroeconomic variables so far. Meanwhile, several transition countries, especially in CEE, tend to make use of institutional devices to reduce the inflation rate. For instance, the Czech Republic, Poland and Hungary have adopted inflation targeting, while other countries make effort to import the lower inflation rate by pegging exchange rate with the anchor currency. In this chapter, I analyze the effectiveness of these monetary policy frameworks and the other relevant factors on disinflation by using regression on panel data.

2. 1 Model Specification

The estimated models are constructed based on the literature. That is, as the regressions are not based on a particular structural model, they include main variables which explain the inflation rate in earlier empirical studies of transition economies. The basic model to estimate can be written as

\[ \text{INF}_i,t = \alpha + \beta \text{FW}_i,t + \gamma \text{Bud}_i,t + \delta \text{M2}_i,t + \epsilon \text{LI}_i, t + \zeta \text{CBI}_i,t + \eta \text{INF}(-1)_i,t + \mu_i,t \]

(A)

where \( i = 1, \ldots, N \) is the cross-section dimension; and \( t = 1, \ldots, T \) is the time dimension.

The dependent variable is the inflation rate (INF). The independent variables are the specific policy framework (FW), government budget surplus (Bud), money supply growth (M2), and the indices of economic liberalization (LI) and central bank independence (CBI). FW consists of two kinds of dummy variables which represent the adoption of inflation targeting (IT) and the exchange rate peg (EX). \( \alpha \) stands for country-specific effects, and \( \mu \) is the error term. I allow for the intercept to vary across countries, assuming that these constants capture the effect of initial conditions.

2. 2 Data and Variable Description

This paper uses annual data during 1995 - 2003 for 20 transition countries: 10 countries from CEE, and 10 countries from the FSU.

The effects of policy frameworks were captured by the dummy variables, IT and EX. The variable IT takes a value of one when inflation targeting is introduced and zero otherwise. Similarly, the variable EX has a value of one when a country is under the fixed exchange rate regime and a value of zero otherwise. Since both inflation targeting and the exchange rate peg aim at price stability as the final objective, I presumed that the countries under these frameworks would have lower inflation rate.

Next, concerning Bud, the sign of the coefficient was assumed to be negative with respect to the inflation rate.
It is true that the newly enacted central bank legislation limits or prohibits the central bank's direct credit to the government in most CEE countries, but I expected inflation to be higher the larger the fiscal deficit. I also anticipated that the sign of the coefficient for $M2$ would be positive. The reason is that money supply growth is often singled out as the determinant of inflation in the long run, although both aggregate demand and aggregate supply side factors can raise the rate of inflation in the short run.

The extent of economic reform was measured as $LI$ and its sub-components ($Inter$ and $Exter$ plus $Pri$). As most empirical literature on transition countries uses $CLI$ as well as $LI$, this paper also made use of the cumulative index and it's sub-components. Following the literature, I anticipate that the greater degrees of economic liberalization have an overall negative effect on the inflation rate, although the sub-indices are expected to have divergent impacts on the inflation rates.

Finally, $CBI$ was provided by Cukierman et al. (1992) (2000). Like the economic liberalization index, I used the yearly and the cumulative $CBI$ ($CCBI$) to capture the depth of central bank reforms in the transition economies. The expected sign is based on the literature. The theoretical studies suggest that if political pressures lie behind the bias toward economic expansions that the Barro - Gordon model shows leads to an inflationary bias, independent central banks that are less...
subject to political influences should be able
to deliver consistently lower inflation
(Walsh, 2000, p. 376). Therefore, I ex-
pected that the coefficient sign would be
negative.

Appendix provides the descriptive statis-
tics, the detailed definitions and the sources
of all variables mentioned above.

2.3 Empirical Results

Before estimating, I tested for the sta-
tionarity of series by applying the panel data
unit root tests given by Im, Pesaran and Shin
(2003, IPS hereafter). If the unit root tests
show that all the variables are found to be
stationary, traditional estimation methods
can be used to obtain the long run rela-
tionship between the variables. Otherwise, more
care is required.

As the result of IPS Dickey - Fuller test,

| Table 3 | Regressor Results for Inflation in 20 Transition Countries, 1995-2003 (1) |
|---------|-----------------------------------------------|
| Dependent variable: INF                           |
|          | 1       | 2       | 3       | 4       |
| EX       | -0.052  | (-3.44) |        |        |
| Bud      | -0.007  | (-2.61) |        |        |
| M2       |         |        | 0.430  | (3.43) |
| LI       |         |        | 0.145  | (2.23) |
| LI(-1)   |         |        | -0.319 | (-5.61)|
| Inter    |         |        | 0.039  | (1.70) |
| Exter plus Pri |    |        | -2.02  | (-6.04)|
| CLI      | -0.003  | (-10.28)|        |        |
| CBI      |         |        | -0.003 | (-7.72)|
| Adj.R- sq| 0.525   | 0.741   | 0.584  | 0.472  |

* Numbers in parenthesis under the coefficients are t-ratios based on heteroskedasticity-adjusted standard errors.

| Table 4 | Regression Results for Inflation in 20 Transition Countries, 1995-2003 (2) |
|---------|---------------------------------------------------------------|
| Dependent variable: INF | 5 | 6 | 7 | 8 | 9 | 10 |
| IT       | -0.049  | -0.048 | -0.042 |        | -0.049 | -0.050 |
| EX       |         |         |         | -0.049 | -0.050 |
| Bud      | -0.007  | -0.008 | -0.006 | -0.007 | -0.005 | -0.005 |
| M2       | 0.351   | 0.361  | 0.369  | 0.342  | 0.363  | 0.373  |
| LI       | -0.049  | -0.047 | -0.046 | -0.073 |        |        |
| Inter    |         | 0.034  | (2.06) |        |        | 0.034  |
| Exter plus Pri | -0.069 | (-3.59) |        |        | -0.090 | (-5.00) |
| CBI      | 0.017   | 0.015  | -0.057 | -0.037 | -0.041 |        |
| INF(-1)  | 0.268   | 0.260  | 0.268  | 0.273  | 0.259  | 0.252  |
| Adj.R- sq| 0.754   | 0.767  | 0.728  | 0.743  | 0.77   | 0.789  |

* Numbers in parenthesis under the coefficients are t-ratios based on heteroskedasticity-adjusted standard errors.
I find that INF, M2 and Bud reject the unit root null at 1% level, while CLI, its sub-components and CCBI cannot reject the null hypothesis even at 5% level when they do not include time trend (results not shown). It means that the cumulative indices of economic liberalization and central bank independence are non-stationary. In order to obtain the long run relationship between the variables, I estimate Model (A) using the first difference of the cumulative indices which correspond to the yearly indices.

Table 3 and 4 report the regression results obtained from the fixed effects model. Panel estimations were performed using generalized least squares controlling for heteroskedasticity across panels. To begin with, I compare Regression 1, 2, 3 and 4 with the results of the relevant panel analysis in Table 1 and 2. As a whole, we find that the regressions are consistent with the literatures as well as the aforementioned expectation, although there are some differences in statistical significance between them.

Next, I turn to the estimation results of Model (A). The analysis of each result is as follows. Regression 5 and 6 show that by adding the lagged dependent variable as a regressor, the inflation-targeting country lowers the inflation rate by around 4.7%-4.8%, compared with alternative monetary policy regimes. M2 and Bud enter the regressions with the expected signs; that is, the higher the growth rate of money supply and the larger the fiscal deficit are, the higher the inflation rate is. Concerning economic liberalization, Regression 5 clarifies the significant negative association between INF and LI. When the sub-indices (Inter and Exter plus Pri) are substituted for LI, Regression 6 finds that the sub-components have diametrical effects on inflation which is in conformity with the aforesaid expected signs.

So far we have found from the regressions that CBI is of the wrong sign and insignificant. One of the reasons is that legal independence may not be a reasonable proxy of actual independence in transition countries due to poor compliance with the law, which is actually observed in most developing countries (Cukierman, Webb and Neyapti (1992)). The other possibility is multicolinearity caused by high intercorrelation between CBI and other explanatory variables. In particular, there is the possibility that CBI is highly correlated with IT, because central bank independence is often linked with the adoption of inflation targeting and is even regarded as a precondition for inflation targeting. In order to deal with the latter statistical problem, Regression 7 and 8 eliminate either CBI or IT respectively and re-estimate Model (A). Regression 7 shows that the problems concerning CBI are solved partially; when IT is dropped, the sign of CBI changes to negative, but the variable is still insignificant. Meanwhile, we find from Regression 8 that there is still a significant relationship between INF and IT, although the negative impact of IT drops to -4.1%.

Finally, Regression 9 and 10 include EX instead of IT, which find that pegged exchange rate also appears to have been effective in reducing inflation rate like inflation targeting. Compared with Regression 5 and 6 respectively, the basic overall relationship is left unchanged except that the sign of CBI changes to negative.

**Concluding Remarks**

This paper has mainly considered the determinants of the inflation rates in transition countries, focusing upon the policy frameworks such as inflation targeting and the exchange rate peg. Based on the relevant empirical studies, Chapter 2
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specifies the models and estimates them using annual data during 1995-2003 for 20 transition countries. The characteristic of the estimated models is that they include the dummy variables representing the adoption of inflation targeting and the fixed exchange rate. The panel data regressions clarify that the countries with these institutional devices have succeeded in lowering inflation, although the estimated results do not mention any causality, but just the correlativity.

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Appendix

Descriptive Statistics, Definitions and Sources of Variables

Descriptive Statistics

| Variable | Mean | Maximum | Minimum | Std.Dev | Skewness | Kurtosis |
|----------|------|---------|---------|---------|----------|----------|
| INF      | 0.195| 2.470   | -0.089  | 0.347   | 3.846    | 20.216   |
| IT       | 0.089| 1.000   | 0.000   | 0.285   | 2.889    | 9.348    |
| EX       | 0.328| 1.000   | 0.000   | 471.000 | 0.734    | 1.538    |
| Bud      | -3.483| 2.900   | -12.900 | 3.056   | -0.535   | 2.888    |
| M2       | 0.256| 1.513   | -0.240  | 0.230   | 2.171    | 10.886   |
| LI       | 6.778| 8.400   | 2.190   | 1.105   | -1.024   | 4.234    |
| Inter    | 6.203| 7.300   | 4.300   | 0.740   | -0.313   | 2.546    |
| Exter plus Pri | 6.623| 8.300   | 2.500   | 1.250   | -1.333   | 4.979    |
| CBI      | 0.565| 0.890   | 0.220   | 0.171   | 0.165    | 2.127    |

**INF**
- The first difference of the natural logarithm of consumer price index (CPI). CPI (1991=100) is derived from the change in annual average retail/consumer price level published in EBRD (2003).

**IT**
- Dummy variable equal to one when a country introduces inflation targeting, and to zero otherwise. The inflation targeting countries are composed of the Czech Republic (1997-2003), Poland (1998-2003) and Hungary (2001-2003).

**EX**
- Dummy variable equal to one when a country is on a fixed exchange rate regime, and to zero otherwise. The fixed exchange rate regime includes currency board arrangements, conventionally fixed pegs and horizontal bands, while the floating exchange rate regime consists of crawling pegs, crawling bands, managed floating and independent floating, which are along the definition of the IMF.

**M2**
- The first difference of the natural logarithm of broad money (local currency, money plus quasi money). Broad money is derived from the IMF (2004).

**Bud**
- General budget balance as a percent of GDP derived from EBRD (2003). A positive sign means budget surplus.

**Inter**
- Index for liberalization in internal market computed from a simple sum of two transition indicators by EBRD (2003): price liberalization and competition policy. Transition indicators rate the progress of economic reforms from 1 to 4 each year. The larger the number is, the more progress the economy makes.

**Exter**
- Index for liberalization in external market which corresponds to the transition indicator by EBRD (2003): foreign exchange and trade liberalization.
Pri

= Index for liberalization in private sector entry computed from a simple sum of three transition indicators by EBRD (2003): small-scale privatization, large-scale privatization and banking sector reform.

LI

= Index for economic liberalization calculated as an average of Inter, Exter and Pri with weights of 0.3, 0.3 and 0.4 respectively.

CLI

= A simple sum of annual liberalization index (LI) up to and including the current year.

Exter plus Pri

= Index for non-price liberalization computed from a simple arithmetic average of Exter and Pri.

CBI

= Index for central bank legal independence provided as LVAW by Cukierman et al. (1992) (2000).

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Notes

1) Most empirical literature on transition countries uses CLI rather than LI. The rationale is that at any given time economic performance is affected by the degree of liberalization at that time, as well as the length of time that particular reforms have been in effect (de Melo et al. (1996)).

2) In order to find the negative relationship, Cukierman et al. (2000) add a dummy variable that assumes the value of one when CLI > 2.0 and the value of zero otherwise, and find that CLI becomes insignificant at high levels of CLI though it has a significant negative impact on inflation at low levels of CLI.

3) Here I assume that contemporaneous inflation rate does not determine the regressors. It means that the regressors are weak but not necessarily exogenous with respect to dependent variable.

4) In this paper, all models are estimated as the fixed effects one, so the intercepts are assumed to capture the effects of initial condition.

5) Due to data constraints, the analysis is limited to 20 countries. 10 CEE countries are composed of Albania, Bulgaria, Croatia, the Czech Republic, Hungary, Macedonia FYR, Poland, Romania, Slovakia and Slovenia. The other 10 countries in the FSU include Armenia, Azerbaijan, Belarus, Estonia, Kazakhstan, Latvia, Lithuania, Moldova, Russia and Ukraine. The main reason why I exclude the period before 1995 is the data constraint. Another reason is that the countries in the FSU had been faced with hyperinflation in the initial transition phase since 1990.

6) All panel data studies in Table 1 and 2 do not test for the stationarity of series by applying the panel data unit root tests. So, there is a possibility that they estimate the models using non-stationary variables, such as CLI.

7) According to econometric textbooks, the random effects model is applicable if the panel data comprise N individuals drawn randomly from a large population, whereas the fixed effects model is more appropriate when focusing on a specific set of N individuals that are not randomly selected from some large population. Since the sample data come from transition countries in this paper, the fixed effects model is more suitable for the analysis.

8) Since Goldfeld-Quandt test indicates that the null hypothesis that the error term is homoskedastic is rejected at 5% level of significance, I estimated Model (A) by GLS.

9) Regression 1, 2, 3 and 4 in Table 3 correspond to Fischer et al. (1996), de Melo et al. (1997), Hernandez-Cata (1999) and Cukierman et al. (2000) respectively.

10) Durbin-W test shows that the null hypothesis that there is no serial correlation can not be rejected at 5% level of significance.

11) This value of inflation rate is computed from \(\{\exp (\text{coefficient}) - 1\} \times 100\), since IT is a dummy variable.
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Abstracts

The Determinants of the Inflation Rate in Transition Countries — A Panel Data Analysis —
Takeshi Inoue (Graduate School of Economics, Kobe University, Ph.D student)

The theoretical literature points out that inflation targeting and the exchange rate peg have the advantage of lowering the inflation rate. Controlling for the other relevant variables, this paper estimates the effects of these policies on the inflation rate in 20 transition countries during 1995—2003 by using regressions on panel data. The main finding is that inflation targeting and the exchange rate peg appear to have been effective in lowering inflation rate even in transition countries.

Micro Foundation of Worship of the Kims
Makoto Kurosaka (Osaka University of Economics)

It is well known that worship of the Kims has been strengthened in North Korea. This paper analyzes this mechanism. The paper proposes two kinds of models which depict the North Korean system. The first one is a case where North Korean authorities can directly decide the labor allocation of people. The second one is a case where North Korean authorities make contracts with people. The result shows that low levels of reservation income is the origin of the strengthening worship of the Kims.

Political Economic System and Food Entitlement in North Korea: Su-ryong (the Leader) economy and Hierarchy of Entitlement
Kwang-min Jeong (Nagoya University Graduate School of Economics, Ph.D student)

This article attempts to analyze the correlation between Su-ryong economy that is a core sector in North Korea's political economic system and food entitlement as a study of North Korean urban famine. In North Korea, Public Food Distribution system is characterized by hierarchic structure that privileges the ruling class, especially Su-ryong and his families. The economic basis to ensure the privilege of the ruling class is the Su-ryong economy.

NORTH KOREAN ECONOMIC ADJUSTMENT POLICY: A COMPARISON WITH CHINESE ECONOMIC REFORM POLICY
Hiroko IMAMURA (Center for Far Eastern Studies, Toyama University)

In July 2002, North Korea announced a series of economic adjustment policies. This paper compares the adjustment policy of North Korea with the reform policy of China. North Korea, unlike China, had no real change in the political regimes and, therefore, it was inevitable that the reform would not be very comprehensive. In any reform, a proper "sequence" of reforms is important. North Korea ignored the proper sequence of reform. For instance, in North Korea price reform was implemented first without securing an adequate supply of food and consumer production despite an acute shortage of supply in