Currency Boards, Expectations and Inflation Persistence

J. A. Carlson
Purdue University

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Purdue University

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by John A. Carlson and Neven T. Valev
Purdue University

Abstract

Adopting the exchange rate as a nominal anchor for monetary stabilization has proved costly in a number of countries as inflationary inertia produces severe real exchange rate appreciation. What causes inflation persistence? Complementary to existing explanations such as staggered contracts and low credibility, we note that the introduction of a new monetary rule, such as a fixed exchange rate reduces inflationary expectations immediately to the target level only if all agents understand the implications of the rule. We solve a simple model in the style of Barro-Gordon (1983) to trace the implications of heterogeneity among agents in their ability to evaluate the new monetary rule. The predictions of the model find support in data obtained from a survey on inflationary expectations conducted in Bulgaria immediately before the introduction of a currency board in that country.

JEL Classification: E63 Stabilization Policy

Address correspondence to:

John A. Carlson
Department of Economics
Purdue University
West Lafayette, IN 47907

Telephone: 765-494-4450
Fax: 765-494-9658
e-mail: carlson@mgmt.purdue.edu

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1. Introduction.

Monetary stabilization often involves the adoption of a nominal anchor. For open economies, the most common choice, given its transparency, is to peg the nominal exchange rate to the currency of a low-inflation country. Provided that the government holds sufficient foreign exchange reserves and that tradables represent a sufficient portion of total output, inflation and expectations of inflation should decline to the levels of the reserve currency as soon as the exchange rate is pegged. The experience with adopting the exchange rate as a nominal anchor, however, suggests that inflation only gradually converges to low levels. It takes months, sometimes longer, before it declines to levels close to that of the reserve currency. In the process, real exchange rates appreciate and the countries start to run current account deficits. If the real appreciation is severe, eventually a devaluation is inevitable and the peg of the exchange rate is often abandoned. What accounts for the slow decrease in inflation?

The most commonly suggested explanation of inflationary inertia is the existence of staggered contracts (Calvo (1983), Bruno (1991)). Indeed, wage indexation, inherited from a high-inflation period, has been singled out as the main reason for real appreciation in a number of countries. Abolishing wage indexation, however, along with the introduction of a pegged exchange rate in some countries (Argentina in 1991, Israel in the mid 1980's) has not produced an immediate drop of inflation to single digits, indicating that there could be additional reasons for inflation persistence.¹

As an alternative (or a complementary) explanation, inflation may persist because of insufficient confidence in the viability of the fixed exchange rate regime. Low
credibility produces expectations of devaluation and inflation which are transformed into nominal interest rate and commodity price premiums.\footnote{See Obstfeld (1995), Dornbush \textit{et al} (1995), Bruno (1991), Fischer (1986) for a discussion of these issues.} Thus, the speed with which inflation declines depends on the success with which authorities convince the public in the viability of the fixed parity. To achieve that goal, stabilization plans often involve more than the fixing of the exchange rate. Special institutional arrangements may be introduced in order to enhance the credibility of the stabilization plan. Currency boards are examples of such institutional arrangements.

Currency boards are institutions that replace central banks and ensure that domestic currency can be purchased on demand at a fixed exchange rate.\footnote{See Obstfeld (1995).} The fixed level of the exchange rate can be altered only by a Parliamentary vote and, in addition, domestic money is fully backed by foreign exchange reserves held by the government. Currency boards thus introduce a rule of monetary policy characterized by transparency and high (political) costs to deviation and, hence, are expected to bring a high degree of credibility to the stabilization plan. However, the recent experience of Estonia (1992) and Argentina (1991) shows that even with currency boards inflation declines slowly. Why would inflation not decline immediately if wages are not indexed and the fixed exchange rate seems viable at least for a few years?

Note that the introduction of a new monetary rule consistent with low inflation reduces inflationary expectations only if agents understand the implications of the rule. It is plausible that agents in the economy differ in their ability to evaluate the new monetary rule and to incorporate that understanding into the formation of inflationary expectations.
Some agents may lack such ability and, instead, use lagged inflation to form expectations. Thus, when a new monetary rule is introduced, some agents incorporate it in the formation of their expectations, i.e. they form rational expectations while others form adaptive expectations. We adopt a Barro-Gordon (1983) framework to trace the implications of such heterogeneity among agents. We show that the introduction of a new monetary rule consistent with low long-term inflation does not immediately reduce inflationary expectations and inflation to long-term levels. However, agents with rational expectations hold lower inflationary expectations than agents with adaptive expectations. Inflation persistence is directly related to the proportion of agents with adaptive expectations. We also show that the future introduction of a new monetary rule affects the choice of current inflation. In particular, current inflation may decrease in anticipation of such an event.

We test some of the implications of the model using the results of a survey on inflationary expectations in Bulgaria conducted immediately before the introduction of a currency board in that country. In that survey, respondents were asked to provide their inflationary expectations for the following year conditional on the introduction of the currency board as well as their inflationary expectations if a currency board were not introduced. The study is unique in the sense that it captures a very specific moment. First, the introduction of a currency board is an event with very low frequency. Second, the survey was carried out immediately before the introduction of the currency board but after the legislation and all parameters of the board were publicly announced. In this sense, there was no uncertainty about the level at which the nominal exchange rate will be fixed, about the members of the board or about the fiscal position of the government.
The implications of the model find support in the data. We used level of education to differentiate agents with respect to their ability to evaluate and thus incorporate the new monetary rule in their expectations. We assumed that agents with higher education level should possess a stronger ability to form rational expectations. Given that a currency board is introduced, agents with higher education level (more with rational expectations) expect lower inflation than agents with lower education level (more with adaptive expectations). However, if a currency board were not introduced, the ability to evaluate the new monetary rule should be irrelevant. We find that education does not explain differences in expected inflation given that a currency board is not introduced.

The rest of the paper is structured as follows. In the next section, we trace the implications of heterogeneous population in a simple model in a Barro-Gordon (1983) framework. In sections 3 and 4, we discuss the survey data and present our findings. We conclude with final remarks.

2. Monetary policy with heterogeneous agents.

Output $y_t$ (all variables in logarithms) differs from its natural level by an amount determined by the real wage $(w_t - p_t)$:

\[ y_t = \bar{y} - (w_t - p_t) - u_t \]

where $u_t$ is an i.i.d. supply shock with mean zero and variance $\sigma^2$. Inflation $\pi_t$ is defined by:

\[ \pi_t = p_t - p_{t-1} \]

Before observing $u_t$, wages are set to keep output at its natural level:

\[ w_t = E_{t-1}p_t \]
Agents are heterogeneous in the way they form inflationary expectations. A proportion \( \theta \) of all agents form adaptive expectations:

(4) \[ E_{t-1}^A \pi_t = \pi_{t-1} \]

which yields:

(5) \[ E_{t-1}^A p_t = p_{t-1} + \pi_{t-1} \]

The remaining \((1 - \theta)\) agents form rational expectation. Denote their expectation of the price level by \( E_{t-1}^R p_t \). The nominal wage is given by:

(6) \[ w_t = \theta (p_{t-1} + \pi_{t-1}) + (1 - \theta) E_{t-1}^R p_t \]

Define the monetary authorities’ loss function \( L_t \) as:

(7) \[ L_t = (y_t - \bar{y}_t)^2 + \alpha \pi_t^2 \]

where \( \bar{y}_t \) is the level of output targeted by the policymaker. By substituting (6) into (1) and (1) into (7), we write the loss function as:

(7') \[ L_t = [\pi_t - (1 - \theta) \pi_{t-1} - \theta \pi_{t-1} - k_t - u_t]^2 + \alpha \pi_t^2 \]

where \( \pi_{t-1} = E_{t-1}^R p_t - p_{t-1} \) is expected inflation by agents with rational expectations and \( k_t = \bar{y}_t - \bar{y} \) is the difference between the target and the natural level of output.

After observing the nominal wage (6) and the shock \( u_t \), the government chooses inflation \( \pi_t \) to minimize:

(8) \[ \min_{\pi_t} \sum_{i=0}^{\infty} \beta^i E \left( L_{t+i} | L_t \right) \]

where \( \beta \in [0,1] \). We reduce (8) to a two-period dynamic programming problem:

(8') \[ \min_{\pi_t} \left( [\pi_t - (1 - \theta) \pi_{t-1} - \theta \pi_{t-1} - k_t - u_t]^2 + \alpha \pi_t^2 + \beta E(L_{t+i} | L_t) \right) \]
Assuming that \( k_{t+i} = k \) for all \( i \) we rewrite (8') as:

\[
(8'') \quad \min_{\pi_t} \left\{ \pi_t - (1 - \theta)\pi_t - \theta\pi_{t-1} - k - u_t \right\}^2 + \alpha\pi_t^2 + \beta \frac{\alpha(1 + \alpha)}{(\alpha + \theta)} \left( \theta\pi_t + k \right)^2 + \sigma^2 \right\}
\]

Monetary authorities choose inflation to achieve a balance between its inflation and output objectives. Provided that some agents form adaptive expectations \((\theta > 0)\) there is an additional cost to raising inflation in period \( t \) in terms of the objectives in period \( t+1 \) as inflation in period \( t \) is built into expectations of inflation for period \( t+1 \) (third term in (8'')).

The first order condition with respect to \( \pi_t \) yields:

\[
(9) \quad \pi_t = \frac{(1 - \theta)(\alpha + \theta)^2\pi_t + \theta(\alpha + \theta)^2\pi_{t-1} + k[(\alpha + \theta)^2 - \beta\alpha\theta(1 + \alpha)] + (\alpha + \theta)^2u_t}{(1 + \alpha)(\alpha + \theta)^2 + \beta\alpha\theta^2}
\]

A rational expectations equilibrium implies that \( \pi_t = E_{t-1}\pi_t \), which yields expected inflation by agents with rational expectations:

\[
(10) \quad \pi_t = \frac{\theta(\alpha + \theta)^2}{(\alpha + \theta)^2 + \beta\alpha\theta^2(1 + \alpha)} \pi_{t-1} + \frac{(\alpha + \theta)^2 - \beta\alpha\theta(1 + \alpha)}{(\alpha + \theta)^2 + \beta\alpha\theta^2(1 + \alpha)} k
\]

To obtain a solution for actual inflation, we can substitute (10) into (9). However, to get some insight into the dynamics of the problem we begin our analysis in Section 2.1 with the algebraically simpler case when \( \beta = 0 \). Then, in Section 2.2, we relax that assumption.

2.1. Last year in office.

In this section we assume that the future is discounted completely, i.e. \( \beta = 0 \). Expression (10) reduces to:

\[^4\text{See Appendix 1 for the derivation of } E(L_{t+i}/t).\]
Substituting (11) into (9) with $\beta = 0$, yields actual inflation:

\[
\pi_t = \frac{\theta \pi_{t-1} + k}{\alpha + \theta}
\]

Long-term inflation with $\pi_t = \pi_{t-1}$ and $\pi_t = 0$ is $k/\alpha$. There are several interesting points about (11) and (12). Note from (12) that inflation is correlated across periods if some agents form adaptive expectations:

\[
\pi_t = \frac{\theta (1 + \alpha) \pi_{t-1} + (1 + \alpha) k + (\alpha + \theta) \mu_t}{(1 + \alpha)(\alpha + \theta)}
\]

Thus, a shock in period $t-1$ that raises inflation in period $t-1$ will also raise inflation in period $t$. In that sense the effect of shocks spills over into subsequent periods. If monetary authorities lack any resolve to fight inflation ($\alpha = 0$), the process of inflation contains a unit root ($\partial \pi_t / \partial \pi_{t-1} = 1$). If $\alpha > 0$, the effect of a shock diminishes over time ($\partial \pi_t / \partial \pi_{t-1} < 1$). In terms of inflation persistence, note that, coming from a period of high inflation ($\pi > k/\alpha$), the speed with which inflation declines is inversely related to the proportion of agents with adaptive expectations. However, while inflation declines, agents with rational expectations hold lower inflationary expectations than agents with adaptive expectations:

\[
\pi_{t-1} - \pi_t = \frac{\alpha \pi_{t-1} - k}{\alpha + \theta} > 0 \quad \text{if} \quad \pi_{t-1} > \frac{\alpha}{k}
\]

That difference increases in the weight authorities place on fighting inflation ($\alpha$).
Finally, coming from a period of high inflation \((\pi > k/\alpha)\), expected inflation by agents with rational expectations increases in the proportion of agents with adaptive expectations:

\[
\frac{\partial \pi^e}{\partial \theta} = \frac{\alpha \pi_{t-1} - k}{(\alpha + \theta)^2} > 0 \quad \text{if} \quad \pi_{t-1} > \frac{k}{\alpha}
\]

In other words, agents with rational expectations expect higher inflation because they are aware of the existence of more agents with adaptive expectations.

We now look at the above dynamics from a different perspective. The monetary authorities of a high inflation country, in an effort to stabilize inflation, adopt the preferences of some other, low-inflation country at time \(T\). The shift in preferences is defined as

\[
\alpha_t = \begin{cases} 
\alpha & \text{if } t < T \\
\alpha^* & \text{if } t \geq T 
\end{cases}
\]

where \(\alpha^* > \alpha\). The long-run inflation consistent with \(\alpha^*\) is \(k/\alpha^* < k/\alpha\). To fix ideas, assume that \(\pi_{t-1} = k/\alpha\) and \(u_{T+i} = 0, i \geq 0\). How rapidly does inflation reach its new long-run level following the adoption of the new preferences?

Expected inflation for period \(t\) by agents with adaptive expectations is \(k/\alpha\). Expected inflation (which equals actual inflation since \(u_r = 0\)) by agents with rational expectations can be found from equation (11) with \(\pi_{t-1} = k/\alpha\) to be:

\[
\pi^e_r = \frac{k}{\alpha^*} \quad \frac{\theta + \alpha}{\theta + \alpha^*} \begin{cases} > k/\alpha^* \\
< k/\alpha \end{cases}
\]

Clearly, inflation does not immediately decrease to long-term levels by the introduction of the new monetary rule. As noted earlier, the speed of convergence is directly related to the proportion of agents with adaptive expectations. At the introduction of the new
monetary rule, agents with rational expectations expect lower inflation than agents with adaptive expectations. The wedge between expectations increases in \((a^*-a)\), the magnitude of the shift in policy preferences. Yet, agents with rational expectations expect higher than long-term inflation because they are aware of the existence of agents with adaptive expectations. If the new monetary rule were not introduced, both type of agents expect \(k/\alpha\). This can be seen from (17) with \(a^*=a\).

2.2 First year in office.

In this section, we investigate how the dynamics of inflation change when \(\beta>0\). With \(\beta>0\), in setting current inflation, monetary authorities take into account its effect on future inflationary expectations as current inflation is built into the inflationary expectations of agents with adaptive expectations.

Expression (10), rewritten below, is expected inflation by agents with rational expectations:

\[
\pi_e = \frac{\theta(a+\theta)^2}{(a+\theta)^2 + \beta\alpha\theta(1+\alpha)} \pi_{e,-1} + \frac{(a+\theta)^2 - \beta\alpha\theta(1+\alpha)}{(a+\theta)^2 + \beta\alpha\theta(1+\alpha)} k
\]

Note that agents with rational expectations expect lower inflation the higher \(\beta\) is. In other words, greater "concern" of monetary authorities about the future effects of current inflation is built into the rational agents' expectations.

Further, inflation is less persistent when \(\beta\) is larger \((\frac{\partial^2\pi_e}{\partial\pi_{e,-1}\partial\beta} < 0)\). Monetary authorities are more willing to reduce current inflation in order to reduce inertia in inflationary expectations.

The monetary authorities' response to supply shocks also depends on \(\beta\). From (9):
Larger $\beta$ implies a smaller increase in inflation for a given supply shock $u_t$.

Finally, in the spirit of our discussion in the previous section, let a stabilization effort by the monetary authorities consist of adopting a greater weight on inflation in the loss function at time $t+1$. The two-period dynamic programming problem (8'') with $\alpha_i=\alpha$ and $\alpha_{t+1}=\alpha^*$ is:

$$(8'') \quad \min_{\pi_t} \left\{ \pi_t - (1-\theta)\pi_{t-1} + k - u_t \right\}^2 + \alpha \pi_t^2 + \beta \alpha^* \frac{(1 + \alpha^*)}{(\alpha^* + \theta)^2} \left( \theta \pi_t + k \right)^2 + \sigma^2$$

and yields expected inflation by agents with rational expectations:

$$(10') \quad \pi_t = \frac{\theta(\alpha^* + \theta)^2}{(\alpha^* + \theta)^2(\alpha + \theta) + \beta \alpha^* \theta^2(1 + \alpha^*)} \pi_{t-1} + \frac{(\alpha^* + \theta)^2 - \beta \alpha^* \theta(1 + \alpha^*)}{(\alpha^* + \theta)^2(\alpha + \theta) + \beta \alpha^* \theta^2(1 + \alpha^*)} k$$

With $\beta>0$, inflationary expectations incorporate both the current and the future weights on inflation in the monetary authorities' loss function.

Let $\pi_{t-1}=k/\alpha$ and $u_t=0$. If a new monetary rule is not introduced, expected inflation (by all agents) and actual inflation in period $t$ is $k/\alpha$.

To see the effect of a future monetary rule on current inflation, substitute $k/\alpha$ for $\pi_{t-1}$ in (10') and subtract $k/\alpha$ from $\pi_t$:

$$(19) \quad \frac{\pi_t - k}{\alpha} = - \frac{\beta \alpha^* \theta(1 + \alpha^*)(\alpha + \theta)k}{\alpha(\alpha^* + \theta)^2(\alpha + \theta) + \beta \alpha^* \theta^2(1 + \alpha^*)}$$

With $\beta>0$, current expected inflation is lower in anticipation of the introduction a new monetary rule.
2.3 Some empirical implications.

Based on the model, in the empirical part of the paper we test the following hypotheses:

1. Expected inflation immediately following the introduction of a new monetary rule are higher than the long-term level of inflation consistent with that rule for both agents with rational and agents with adaptive expectations.

2. Agents with rational expectations hold expectations of lower inflation than agents with adaptive expectations.

3. If a new monetary rule is not introduced, the ability to evaluate such a rule does not explain differences in inflation expectations.

3. Description of the survey

A survey was conducted in Bulgaria during the last two weeks of June 1997 immediately before the introduction of a currency board on July 1st. By mid June, the fixed level of the exchange rate and the members of the currency board were announced. The size of the survey (1022 respondents) is considered representative for the country. It was conducted as part of a larger survey on political attitudes and current economic conditions. We used two of the questions from the survey. In the first, each respondent was asked about her/his expectation of the average monthly inflation over the following year if a currency board is introduced and, in the second, about her/his expectation of the average monthly inflation over the following year if a currency board is not introduced. Monthly rather than annual rates of inflation were chosen because at that time, after a

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5 Appendix 2 provides a brief background on the economic conditions in Bulgaria prior to the introduction of a currency board.
period of high and unstable inflation, price movements were generally discussed and quoted in the media in terms of monthly rather than yearly changes.

Respondents also indicated their age, education level, gender, place of residency, political attitudes and current occupation. Income data were provided by too few respondents to be usable in the estimations.

4. Results.

Approximately 30% of the respondents did not provide an inflation forecast. With few exceptions, respondents provided either forecasts for inflation with and without a currency board or none at all. The estimates of a probit model in which the decision to provide a forecast is explained by demographics are reported in Table 1. Respondents with higher education, respondents who are employed, male and younger respondents are more likely to provide an inflation forecast.

In Table 2, we show the mean expected monthly inflation with and without a currency board. We report the means for the overall sample as well as for some demographic subsamples. Also included is the percent of respondents who provide a forecast between 0 and 10% (low inflationary expectations compared to the mean). For completeness, we also report coefficients of variation calculated as standard deviation divided by the mean.

Average expected monthly inflation with a currency board is 24.96%. Without a currency board, average expected monthly inflation is 50.36%. With a currency board, 50% of all respondents expect inflation within the 0-10% range and without a currency board, 27% of respondents expect inflation in the 0-10% range. Clearly, the introduction
of a currency board is consistent with lower expected inflation but does not by itself lower expectations to desired levels (the inflation of the German mark).

According to the model, the differences in expectations stem from the better ability of some agents to evaluate and incorporate the new policy model into their expectations. We use the level of education to proxy for that ability. If a new monetary rule is not introduced, that ability is irrelevant and should not explain differences in expected inflation. Indeed, Table 2 shows that the level of expected inflation with a currency board is inversely related to the level of education of respondents. Respondents with higher education expect monthly inflation of 21.04%, respondents with high school education expect monthly inflation of 22.92% and respondents without high school education 29.92%. Such inverse relationship, however, is not observed for expected inflation without a currency board.

Table 3 provides evidence of the statistical significance of the effect of education on inflation expectations. We report the coefficient estimates of four equations where expected inflation is explained by demographic factors. In equations (1) and (3) expected inflation with and without a currency board is explained by education, gender and age, i.e. what we view as the basic demographic differences and in equations (2) and (4) we add employment status, political attitudes, and place of residency. Expected inflation with a currency board decreases in education. Expected inflation without a currency board, on the other hand, is not significantly explained by education.

The estimates reported in Table 3 also suggest that supporters of the party introducing the currency board expect lower inflation (compared to the average) with a currency board but not so if a currency board is not introduced. Perhaps, in the spirit of
Ito (1990), that effect can be attributed to “wishful thinking” by the segment of population that is politically interested in the successful implementation of the currency board. We also find that female respondents expect lower inflation (compared to the average) with a currency board but not so without one. However, we find it difficult to formulate a plausible explanation for that effect.6

5. Conclusion.

Many stabilization programs based on an exchange-rate peg result in real exchange rate appreciation, current account deficits and, potentially, costly devaluations. It is essential to understand why inflation does not decline to low levels immediately following the introduction of a monetary rule which is consistent with low inflation. Complementary to arguments advanced before -- wage indexation and low credibility -- we suggest that agents in an economy may differ in their ability to understand, evaluate and thus incorporate the new monetary rule in the formation of their inflationary expectations. In other words, agents may differ in their ability to form rational expectations. In a Barro-Gordon (1983) framework, we trace the implications of such heterogeneity. Also, we use survey data on inflationary expectations conducted in Bulgaria immediately before the introduction of a currency board in that country to test some of the predictions of the model. First, inflationary expectations are only partially reversed by the adoption of a new monetary rule consistent with low inflation. Second, agents with rational expectations hold expectations of lower inflation than agents with adaptive

6 Jonung (1981) reports the results of a survey on perceived and expected inflation in Sweden. He finds that, for 1977, perceived inflation among female respondents is significantly greater than perceived inflation by male respondents. That difference is attributed to the greater increase in food prices during that year compared to the increase in the overall consumer price level: “As women are responsible for the major
expectations. If a currency board were not introduced, however, the ability to evaluate monetary rules does not explain differences in inflation expectations.

share of the food purchases within Swedish households, they are more exposed to movements in food prices than men.” With respect to expected inflation, however, such differences are not observed.
References


### Table 1
Demographic determinants of the decision to provide an inflation forecasts
Probit analysis.
Dependent variable = 1 if a respondent provided an inflation forecast, and 0 otherwise
Survey data. June 1997, Bulgaria

<table>
<thead>
<tr>
<th>Independent Variables</th>
<th>Dependent variable = 1 if the respondent provided a forecast of monthly inflation with a currency board, 0 otherwise</th>
<th>Dependent variable = 1 if the respondent provided a forecast of monthly inflation without a currency board, 0 otherwise</th>
</tr>
</thead>
<tbody>
<tr>
<td>Education (0 if primary, 1 if secondary, 2 if higher education)</td>
<td>0.06** [2.10]</td>
<td>0.07*** [2.68]</td>
</tr>
<tr>
<td>Age (0 if &lt;31, 1 if 31-50, 2 if &gt;50)</td>
<td>-0.06** [-3.25]</td>
<td>-0.04** [-2.18]</td>
</tr>
<tr>
<td>Gender (1 if female)</td>
<td>-0.05* [-1.79]</td>
<td>-0.07** [-2.39]</td>
</tr>
<tr>
<td>Employment (1 if employed)</td>
<td>0.04 [1.12]</td>
<td>0.06* [-1.75]</td>
</tr>
<tr>
<td>Vote (1 if today would vote for the party in office)</td>
<td>0.05 [1.53]</td>
<td>0.02 [0.58]</td>
</tr>
<tr>
<td>Capital (1 if resident of the capital)</td>
<td>-0.05 [-1.53]</td>
<td>-0.02 [-0.49]</td>
</tr>
<tr>
<td>Pseudo R²</td>
<td>0.030</td>
<td>0.033</td>
</tr>
<tr>
<td>Number of obs.</td>
<td>1022</td>
<td>1022</td>
</tr>
</tbody>
</table>

Notes: ML estimates. Z-statistics in parentheses. *** significant at the 0.01 level, ** significant at the 0.05 level, * significant at the 0.1 level.
Table 2  
Expected inflation.  
Survey results. June 1997, Bulgaria

<table>
<thead>
<tr>
<th>Category</th>
<th>Mean Inflation with currency board</th>
<th>Coefficient of Variation (a)</th>
<th>Percent of answers in 0-10% range (b)</th>
<th>Number of Respondents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Whole Sample</td>
<td>24.96</td>
<td>1.75</td>
<td>50</td>
<td>691</td>
</tr>
<tr>
<td></td>
<td>50.36</td>
<td>1.46</td>
<td>27</td>
<td>701</td>
</tr>
<tr>
<td>Female</td>
<td>21.07</td>
<td>1.09</td>
<td>50</td>
<td>341</td>
</tr>
<tr>
<td></td>
<td>47.64</td>
<td>1.42</td>
<td>27</td>
<td>342</td>
</tr>
<tr>
<td>Male</td>
<td>28.74</td>
<td>1.96</td>
<td>51</td>
<td>347</td>
</tr>
<tr>
<td></td>
<td>53.25</td>
<td>1.45</td>
<td>28</td>
<td>356</td>
</tr>
<tr>
<td>Respondents</td>
<td>21.04</td>
<td>1.04</td>
<td>55</td>
<td>107</td>
</tr>
<tr>
<td>with higher education</td>
<td>45.62</td>
<td>1.44</td>
<td>27</td>
<td>109</td>
</tr>
<tr>
<td>Respondents</td>
<td>22.92</td>
<td>1.86</td>
<td>54</td>
<td>353</td>
</tr>
<tr>
<td>with high school education</td>
<td>53.72</td>
<td>1.49</td>
<td>30</td>
<td>366</td>
</tr>
<tr>
<td>Respondents</td>
<td>29.92</td>
<td>1.62</td>
<td>49</td>
<td>231</td>
</tr>
<tr>
<td>without high school education</td>
<td>47.21</td>
<td>1.38</td>
<td>41</td>
<td>226</td>
</tr>
<tr>
<td>Below 31 years of age</td>
<td>26.39</td>
<td>2.15</td>
<td>50</td>
<td>189</td>
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<tr>
<td></td>
<td>52.77</td>
<td>1.44</td>
<td>26</td>
<td>183</td>
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<tr>
<td>31–50 years of age</td>
<td>25.69</td>
<td>2.15</td>
<td>51</td>
<td>246</td>
</tr>
<tr>
<td></td>
<td>54.34</td>
<td>1.37</td>
<td>27</td>
<td>258</td>
</tr>
<tr>
<td>Above 50 years of age</td>
<td>23.20</td>
<td>1.17</td>
<td>50</td>
<td>256</td>
</tr>
<tr>
<td></td>
<td>44.71</td>
<td>1.31</td>
<td>45</td>
<td>260</td>
</tr>
</tbody>
</table>

Note: Each respondent was asked to provide a forecast of the average monthly inflation rate over the following year conditional on introducing or not introducing a currency board.  
(a) Coefficient of variation is calculated as standard deviation divided by mean.  
(b) Percent of respondents who expect monthly inflation of less than or equal to 10%.
Table 3
Demographic determinants of expected inflation
Survey data. June 1997, Bulgaria

<table>
<thead>
<tr>
<th>Independent Variables</th>
<th>Expected inflation with a currency board</th>
<th>Expected inflation with a currency board</th>
<th>Expected inflation without a currency board</th>
<th>Expected inflation without a currency board</th>
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<tbody>
<tr>
<td></td>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
<td>(4)</td>
</tr>
<tr>
<td>Education (0 primary, 1 secondary, 2 higher education)</td>
<td>-5.33** [-2.17]</td>
<td>-6.08** [-2.03]</td>
<td>-0.30 [-0.07]</td>
<td>1.29 [0.25]</td>
</tr>
<tr>
<td>Age (0 if &lt; 31, 1 if 31-50, 2 if &gt;50)</td>
<td>-2.91 [-1.39]</td>
<td>-2.06 [-1.24]</td>
<td>-4.95 [-1.27]</td>
<td>-4.68 [-1.28]</td>
</tr>
<tr>
<td>Gender (1 if female)</td>
<td>-7.26** [-2.25]</td>
<td>-7.12** [-2.21]</td>
<td>-5.54 [-1.00]</td>
<td>-5.59 [-1.01]</td>
</tr>
<tr>
<td>Unemployed (1 if unemployed)</td>
<td>5.56 [1.45]</td>
<td>5.56 [1.45]</td>
<td>0.02 [0.01]</td>
<td>0.02 [0.01]</td>
</tr>
<tr>
<td>Capital (1 if resident of the capital)</td>
<td>-1.13 [-0.32]</td>
<td>-5.61 [-1.68]</td>
<td>-8.49 [-1.43]</td>
<td>2.93 [0.53]</td>
</tr>
<tr>
<td>Vote (1 if today would vote for the party in office)</td>
<td>-5.61 [-1.68]</td>
<td>2.93 [0.53]</td>
<td>2.93 [0.53]</td>
<td>2.93 [0.53]</td>
</tr>
<tr>
<td>$R^2$</td>
<td>0.016 691</td>
<td>0.023 691</td>
<td>0.004 701</td>
<td>0.007 701</td>
</tr>
</tbody>
</table>

Notes: OLS. T-statistics in parentheses. *** significant at the 0.01 level. ** significant at the 0.05 level. * significant at the 0.1 level. Dependent variables is expected monthly inflation.
Appendix 1. Derivation of $E(L_{t+1}|t)$.

\[
\min_{\pi_{t+1}} E(L_{t+1}|t) = E\left[\pi_{t+1} - (1 - \theta)\pi_{t+1} + \theta \pi_t - k - u_{t+1}\right]^2 + \alpha \pi_{t+1}^2 | t \right) = \\
= \left[\pi_{t+1} - (1 - \theta)\pi_{t+1} - \theta \pi_t - k\right]^2 + \alpha \pi_{t+1}^2 + \sigma^2
\]

The first order condition yields:

\[
\pi_{t+1} = \frac{(1 - \theta)\pi_{t+1} + \theta \pi_t + k}{1 + \alpha}
\]

A rational expectation equilibrium implies that $\pi_t = E_t \pi_t$ which yields expected inflation by agents with rational expectations:

\[
\pi_{t+1} = \frac{\theta \pi_t + k}{\theta + \alpha}
\]

With $u_{t+1} = 0$, $\pi_{t+1} = \pi_{t+1}$. To obtain the value function for period $t+1$, we substitute (A3) into (A1):

\[
E(L_{t+1}|t) = \frac{\alpha(1 + \alpha)}{(\alpha + \theta)^2} (\theta \pi_t + k)^2 + \sigma^2
\]

Figures 1 and 2 show the monthly inflation rate and the level of the exchange rate of the domestic currency *vis-à-vis* the USD from April 1996 to 1997. Monthly inflation stayed at around 15-20 percent over that period with a peak of 43 percent in January 1997 and 242 percent in February 1997 giving an average of 36 percent for the period. The exchange rate increased from around 70 leva for one USD (a level maintained for two years), to 2050 in February and back to 1600 in the end of March. For a few days in the beginning of March, it peaked at 3000 leva for one USD and at that time most of the economy was dollarized.

The crisis began with the failure of several major banks in the first months of 1996. By the beginning of 1997, that had been followed by runs on almost all banks and currency flight. The foreign exchange reserves of the central bank decreased from USD1236 million in the beginning of 1996 to USD380 million in the beginning of 1997.

In December, 1996, with the initiative by the IMF, the idea of a currency board was publicly introduced. Following Parliamentary elections in April 1997, the legislation for a currency board was passed and the system was introduced on July 1st, 1997. The lev was fixed at the level of 1 lev=1000 German marks which was approximately the current market price. The period leading to the introduction of the currency board can be characterized by an increased level of uncertainty and uneasiness with the possible effects of the currency board on unemployment, the banking system, government expenditure, etc. Nevertheless, public objections were few.
Figure 1. Monthly percentage change of CPI. April 1996 -- April 1997.

Figure 2. Exchange rate of Bulgarian lev vis-a-vis the USD. April 1996 -- April 1997.
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