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ABSTRACT

On the ‘Conquest’ of Inflation*

Sargent (1999) warns that if policy makers’ views on the unemployment-inflation trade-off are driven by empirical correlations, rather than theory, disinflations (escapes from high to low inflation) may periodically occur but are not bound to last. This Paper asks how different inflation objectives by the policy maker affect this result. We show that escapes in the neighborhood of zero inflation are less frequent and have a shorter duration, as policy objectives become more inflation averse. A sufficiently (but not infinitely) inflation-averse policy maker never escapes Nash inflation and, on average, yields a lower inflation rate.

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1. Introduction

After experiencing two digit inflation during the seventies most industrialized countries managed to return to low inflation rates. Understanding what caused these large inflation fluctuations is key to assess whether low inflation will be sustained. Different hypotheses have been formulated.

One is that after the seventies policy makers learned the natural rate hypothesis, predicated by Friedman (1968) and others, and understood that the unemployment problem could not be solved by means of sustained inflation. The numerous central bank reforms implemented during the past twenty years, in which a primary role is assigned to the price stability objective in the central bank statute, *may* indeed be rationalized positing that governments understand the expectational nature of the unemployment-inflation tradeoff (e.g. Rogoff, 1985; Cukierman, 1994). While such a view suggests that high inflation is an evil of the past, an alternative hypothesis on the 'conquest' of low inflation, by Sargent (1999), and Cho, Williams and Sargent (2001), offers a less comforting perspective.

The 'conquest' hypothesis also relates policy makers' decisions to disinflate to the evolution of their views on the unemployment-inflation tradeoff. But in contrast to the previous hypothesis, these views are driven by econometric estimates rather than theory. The 'conquest' model posits that the government uses the available empirical evidence to measure the tradeoff, neglecting its true expectational nature. It shows that the econometric practice of discounting past observations, on the basis of a suspected parameter drift, induces the actual estimates to fluctuate over time, validating the initial hypothesis of parameter drift (even if there is no drift in the parameters of the true data generating process). Such a variability in coefficient estimates translates into policy makers' changing views about the unemployment-inflation tradeoff, which in turn causes policy fluctuations.[1] The 'conquest' hypothesis thus suggests that today's low inflation

[1]When the estimated tradeoff is zero, the policymaker has an incentive to choose zero inflation, and an endogenous disinflation episode occurs. Such a situation, however, is unstable because, in the low inflation environment, the policymaker is bound to "re-discover" a non-

rates are unlikely to persist, because of the weak nature of the learning process followed by the policymaker (i.e. its sole reliance on estimates).

But the stylized setup of the 'conquest' model is mute about the effects of *different policy objectives* on the inflation dynamics and the other outcomes of the model. Two considerations motivate our interest into this issue. First, central banks have historically shown different attitudes towards inflation. Indeed, several textbook explanations of heterogenous inflation records appeal to the role of policy objectives (e.g. Cukierman (1992) and Romer (1996)). Understanding whether policy makers with different objectives are all equally prone to succumb to the statistical 'illusions' of an empirical Phillips curve, as described by Cho, Williams and Sargent (2001), is useful to assess the robustness of the conquest hypothesis. Second, monetary reforms occurred during the past two decades, e.g. the setup of independent central banks with a mandate for price stability, provide grounds to presume that in several countries monetary policy objectives have changed since the seventies.[2] Since such reforms do not *necessarily* imply that the natural rate hypothesis was understood, we ask whether a change in policy objectives affects the likelihood that high inflation might strike back within the context of the 'conquest' model. We think this exercise is useful to assess whether modern monetary institutions, endowed with a mandate for price stability, are just as subject as their predecessors to the inflation risks identified by the 'conquest' model.

The paper is organized as follows. The next section presents a basic version of the 'conquest' hypothesis, following Cho, Williams and Sargent (2001). Section 3 analyzes how their results are modified when policy makers have different degrees of aversion to inflation.[3] A final section summarizes the main findings of the

zero tradeoff between unemployment and inflation. This makes it optimal to abandon the low-inflation policy in the attempt to lower unemployment.

[2] In the past decade, monetary reforms assigning explicit anti-inflation mandates were implemented in Canada, New Zealand, the United Kingdom and the 12 countries of the euro area. Cukierman (1998) reports that since 1989, twenty-five countries have upgraded the legal independence of their central banks, compared to only two in the previous forty years.

[3] We exploited Matlab 5.3 powerful Graphic User Interface to write a user-friendly code that allows exercises on the 'Conquest model' to be replicated (and new ones explored) using intutive click-on-commands. The program can be freely downloaded from the web at

analysis.

2. The 'Conquest' hypothesis

2.1. The setup

The model is a version of the one-period economy used by Kydland and Prescott (1977). The government payoff is given by

$$\Omega \equiv -E(U^2 + \beta\pi^2) \tag{2.1}$$

where E is the expectations operator, U and π denote, respectively, the unemployment rate and inflation, while the parameter β indicates the relative weight attributed to inflation by the policymaker. In the experiments performed by Sargent (1999) and Cho, Williams and Sargent (2001) this parameter is assigned a unit value. We therefore set $\beta = 1$ in this Section, where the "escape" argument is summarized, and analyze the role of different β values, i.e. different monetary objectives, in the next Section.

Unemployment is determined by the expectations augmented "Phillips curve":

$$U = U^* - \theta(\pi - \pi^e) + v_1 \tag{2.2}$$

where U^* is the (exogenous) "natural unemployment rate", θ the Phillips curve slope, π^e denotes expected inflation and v_1 is a zero-mean real shock with finite variance σ_{v1}, unknown to both the government and the private sector. Actual inflation may deviate from the planned inflation rate, π^*, which is assumed to be controlled by the government, due to a zero-mean control error v_2 (with finite variance σ_{v2}):

$$\pi = \pi^* + v_2. \tag{2.3}$$

Finally, the private sector is assumed to have rational inflation expectations:

www.dadacasa.com/francesco_lippi or obtained from the authors upon request (non-matlab users may use a compiled version of the program which only requires a PC).

$$\pi^e = \pi^*. \tag{2.4}$$

2.2. Equilibria with knowledge of model

Under the assumption that the government knows the true model of the economy, two equilibria have been discussed in the literature: the Nash Equilibrium and the Ramsey plan. The former is the pair $(\pi^*; \pi^e)$ which solves the government problem of maximizing (2.1) with respect to π^* subject to (2.2) and (2.3) taking π^e as given, which yields $\pi^* = \pi^e = \theta U^*$.[4] The inflation and unemployment outcomes associated with this equilibrium are $\pi = \theta U^* + v_2$ and $U = U^* - \theta v_2 + v_1$.

Under the Ramsey plan, instead, the government maximizes (2.1) with respect to π^* subject to (2.2), (2.3) and (2.4). Due to the latter constraint the government internalizes the effect of its decisions on the private sector expectations. This removes the incentive to create "surprise inflation". The Ramsey plan yields $\pi^* = \pi^e = 0$. Note that while unemployment is the same as under the Nash equilibrium, the inflation rate under Ramsey is $\pi = v_2$, which is smaller than the Nash outcome. As it is well know since Kydland and Prescott (1977), the (inefficiently) high inflation associated to the Nash equilibrium in comparison to the Ramsey plan is due to the fact that the government fails to internalize the effect of its action on expectations.

2.3. An approximating model: the self-confirming equilibrium notion

When the government does not know the true structure of the economy, the model must be enlarged to encompass government "beliefs" about the true structure of the economy (see Sims, 1988 and Sargent, 1999): two different models come into play, the true one (data generating model) and the one perceived by the government, sometimes referred to as the "approximating" model.

In Cho, Williams and Sargent (2001) this means that the government does not know equations (2.2), (2.3), (2.4), and instead uses an approximating model

[4] Recall that neither the government nor the private sector know the realization of the shocks (v_1 and v_2).

that posits a structural relationship between unemployment and realized inflation alone. The approximating model is thus restricted to belong to the following family of curves:

$$U_t = \gamma_0 + \gamma_1 \pi_t + \varepsilon_t \tag{2.5}$$

where γ_0, γ_1 are coefficients to be determined and ε_t is a random term orthogonal to the constant and to π_t. Thus, the policymaker approximating model is misspecified as it fails to recognize the existence of a shifter parameter (the expectations of the private sector, π^e) that positions the Phillips curve (2.2).

Government beliefs are thus described by the vector $\gamma = \begin{bmatrix} \gamma_0 \\ \gamma_1 \end{bmatrix}$. The policy problem is then to maximize (2.1) with respect to π^* subject to (2.5). This yields the government best response function:

$$\pi^* = \frac{-\gamma_0 \gamma_1}{1 + \gamma_1^2} \tag{2.6}$$

The model is closed by requiring beliefs (γ) to satisfy a 'rationality requirement'. In this context, where there exist two models, the equilibrium notion requires the 'wrong' model to be indistinguishable from the correct one in equilibrium. This leads to the "self confirming equilibrium" (SCE) notion. In a SCE, the beliefs are the ones that best conform to the moments of the observable data. The "self-confirming" element of the equilibrium lies in the fact that beliefs feed back to determine the moments of the data that are observed. The moment condition is thus self-referential: government *equilibrium* beliefs imply behavior that produces data whose moment matrices confirm such beliefs.[5] In the model, such a for of "rational" beliefs implies that they satisfy the orthogonality condition:

$$E\varepsilon_t \begin{bmatrix} 1 \\ \pi_t \end{bmatrix} = 0 \tag{2.7}$$

[5] A little more formally, economic outcomes, X, depend on the government beliefs (γ), via government best response $\pi^* = h(\gamma)$ and the data generating process $T()$, i.e. $X = T(h(\gamma))$. Government beliefs, in turn, depend on economic outcomes via equation (2.7), $\gamma = G(X)$. A self confirming equilibrium solves the fixed point problem $\gamma = G(T(h(\gamma)))$.

which identifies γ as the population least square regression vector. Thus, government beliefs are driven by the best statistical fit of the data within the class of models considered.

Sargent (1999) shows that the above specification has a unique self confirming equilibrium under which inflation and unemployment coincide with the Nash outcomes.[6] Moreover, under a conventional learning scheme like least squares estimation of (2.5) the learning process on γ eventually converges on point estimates that satisfy the SCE condition. Thus, if the policy maker estimates (2.5) using ordinary least squares the model predicts that, in the long run (i.e. after the learning process has converged), the economy will converge to the Nash equilibrium and remain there afterwards.[7]

2.4. Suspecting parameter drift: the emergence of fluctuations

Cho, Williams and Sargent (2001) show that the suspect of parameter drift on the part of the government may break such a convergence result.

Parameter drift leads the government to replace least square estimation with a method that discounts past observations (i.e. a "fixed gain scheme"). They show how this instance too has a self confirming flavor: if the government discounts past observations, on the basis of a suspected parameter drift, actual estimates will oscillate over time. Thus the (incorrect) hypothesis of parameter drift appears validated even if there is no drift in the parameters of the true data generating process. This result has an important policy implication: because coefficient estimates fluctuate, policymakers' beliefs on the inflation-unemployment tradeoff change over time, leading to changing inflation policies.

The authors provide a characterization of these fluctuations showing that, under a fixed-gain scheme, the learning process is subject to recurrent episodes of slow convergence toward the SCE and rapid escapes from it towards the zero inflation Ramsey outcome. These "escape dynamics" always push the system toward an outcome associated with the policymaker discovering too strong a version of

[6] The unique SCE of this model is $\gamma = \begin{bmatrix} U^*(1+\theta^2) \\ -\theta \end{bmatrix}$.

[7] Convergence to such an equilibrium, however, may be extremely slow (see Sims, 1988).

the natural rate hypothesis. In fact, during these episodes the government is lead to believe that γ_1 is almost nil, implying that there is no tradeoff between inflation and output, while in reality a short run impact exists.

The key mechanism that triggers the escape dynamics is a movement in π^* (the target level of inflation chosen by the government) which translates one-to-one into movements of π^e, the expectational parameter in the true data generating process (DGP henceforth). It is only when π^*, and thus π^e, starts moving around as a result of a particularly unusual sequence of shocks in the DGP, that the policymaker observes data points $(U_t,\ \pi_t)$ that tend to steepen the estimated Phillips curve (EPC henceforth), making the perceived tradeoff less favorable to exploit.

Figure 4.1 helps us illustrate how an escape from the neighborhood of high (Nash) inflation towards zero (Ramsey) inflation may happen. Let us consider a situation as the one illustrated by $epc1$ and $dgp1$ in the figure. Here the estimated Phillips curve coincides with the true DGP. This is the situation that obtains in a SCE: the expectation parameter π_1^e (and the policy variable, π_1^*) are set at the Nash equilibrium level $\pi_1^e = \pi_1^* = \theta U^*$, the estimated slope of the Phillips curve (the inverse of the slope depicted in the figure) is $\gamma_1 = -\theta$. The data points are clustered around the two overlapping loci $epc1$ and $dgp1$. Now suppose that a sequence of sufficiently large shocks occurs, and that it is influential enough to move the estimated slope of the Phillips curve in either direction.[8] Suppose, to consider a counter-intuitive case, that the new data tend to flatten the estimated Phillips curve. A flattening of the curve means a more favorable tradeoff, which leads the government to *raise* its desired inflation rate from π_1^* to π_2^*. Since the private sector has rational expectations, the shifter parameter in the DGP moves from π_1^e to π_2^e, shifting the true DGP upwards, to $dgp2$. Now the clouds of points generated by the true model are around $dgp2$, above the old cloud: note that this effect steepens the estimate of the Phillips curve slope, γ_1. A steeper tradeoff, in turn, leads to a downward revision of π^* (and π^e), say to π_3^*. Note how the

[8] Here is where the discounting of past observations (i.e. a fixed gain algorithm) is crucial, as it gives the new data sufficient leverage to change the accumulated evidence. This does not happen under least squares.

data that are generated by this new DGP (below the old ones) contribute to a further steepening of the estimated tradeoff. When such a process is started, a few iteration lead the policymaker to believe the Phillips curve is almost vertical. The perceived absence of a tradeoff makes (almost) zero inflation a best response (see 2.6). At this point policy is near the Ramsey outcome, the (time inconsistent) level of inflation. But such an "escape" is not bound to last. As new data accumulate around *dgp*3 (and old data are discounted) the existence of a short run tradeoff is (re)discovered. A slow process of upward revisions in γ_1, converging towards its unique SCE value of $-\theta$, will accompany a gradual rise in inflation.[9]

Sargent (1999) uses the 'conquest' model as a parable of the US inflation history after World War II. In his view, the steady increase in inflation, from 1965 until 1980 may be seen as an episode of convergence toward the SCE-Nash level of inflation: as policymakers *measured* an apparently exploitable unemployment-inflation tradeoff they tried to use it, and inflation increased. Disinflation (i.e. the rapid escape from high inflation toward the Ramsey outcome) came when the data ceased to reveal an exploitable tradeoff.

3. The Role of Policy Objectives

The dismal message of the 'conquest' hypothesis is that the errors of the past will be repeated in future. Government beliefs based on statistical estimates are not acquired for good. This might explain why at the end of the seventies the Phillips curve had almost disappeared while today several policy makers and academics are noticing that the Phillips curve is "alive and well". The risk is that government might be tempted to exploit the tradeoff.

How worrying is that warning? Are all governments (or central bankers) equally bound to fall victims of such statistical illusions? Indeed, the hypothesis that policymakers learned the "natural rate hypothesis" seems at odds with the

[9] To actually *see* the dynamics which underlie Figure 4.1 the interested reader can use our click-on Matlab program (see footnote 3). This allows users to visualize the evolution of the estimated tradeoff and the actual one (DGP) during the relevant phases of a simulation (e.g. escapes), observation after observation.

continued use of econometric estimates of the unemployment-inflation "tradeoffs" by most central banks.[10]

While it is difficult to ascertain whether policy makers learned the natural rate hypothesis after the seventies, something is known about monetary reforms which have been implemented since then with the aim to make monetary policy more committed to fighting inflation. Several central banks have been given independence and a mandate for price stability (Cukierman, 1998) and have displayed behavior which is consistent with an increased aversion to fighting inflation in comparison to the seventies (e.g. Clarida, Gali and Gertler, 2000). A worldwide trend towards more inflation-averse central banks prompts us to ask how the warning of the Conquest model is affected when central banks are given objectives which are more (but not infinitely) averse to inflation.

We do this by means of a simple modification to the original model. While the parameter β, weighting inflation and unemployment in the government objectives, is equal to one in the original setting, we analyze the consequences of different β values (a low β value identifies a policymaker primarily concerned with output fluctuations, see equation (2.1)). For sake of brevity we follow Rogoff (1985) and refer to β as "conservatism". In order to be comparable with the results of Sargent (1999) and Chow, Williams and Sargent (2001), all other parameter settings in our simulations coincide with theirs.[11]

3.1. Conservatism and the frequency of escapes

The first question we investigate is whether escapes (from the neighborhood of the Nash equilibrium towards the zero inflation) are more or less frequent when conservatism is greater.[12]

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[10] Sargent (1999) notes that "the method survived and prospered within the Federal Reserve System".

[11] We also conducted some robustness experiments by replicating the simulations in other points of the parameter space, namely changing the ratio of the two standard deviations σ_{v2}/σ_{v1}. Our results on the role of β do not change qualitatively in a significant way as σ_{v2}/σ_{v1} changes.

[12] A first issue to address in answering this question concerns the escape definition. Cho, Williams and Sargent (2001) define an escape in the space of inflation outcomes (i.e. when actual inflation π gets "sufficiently close" to zero). But, as (3.1) shows, the desired inflation rate π^*, and thus realized inflation π, depend directly on β in our case and correspondingly

At first blush, it might be supposed that more conservative policy makers are relatively more willing to shoot for low inflation and learn "too strong" a version of the natural rate hypothesis. But this is not the case. As β increases, the results of the simulations reveal that the occurrence of an escape becomes less frequent, as shown in the second column of Table 4.1. This indicates that an endogenous disinflation episode becomes less likely as more conservative central bankers are appointed in office. For the parameter set used by Cho, Williams and Sargent (2001), the frequency of escapes becomes almost nil as β converges towards 5.

To understand this result recall how the reaction function of the policymaker (2.6) changes once we take account of β:

$$\pi^* = \frac{-\gamma_0\gamma_1}{\beta + \gamma_1^2} \tag{3.1}$$

This formula gives the optimal inflation level chosen by the policymaker in each period, given its current estimate of the tradeoff. Recall that variation in π^* is the key ingredient needed to trigger an escape. The high inflation aversion of such a central banker translates, via equation (3.1) above, into choices of π^* that are tightly clustered around each other. This can be seen by noting that, for a given change in beliefs, i.e. the vector of variation $[\mathrm{d}\gamma_0 \ \mathrm{d}\gamma_1]$, the amplitude of the resulting adjustment in π^* is decreasing in β.[13] This dampens the vertical displacements in the true data generating process (recall that $\pi^e = \pi^*$). In essence, a more conservative central banker has smaller incentives to adjust the inflation rate in response to a changing tradeoff. Less variation in the desired inflation policy makes it less likely to discover that the estimated tradeoff is vertical, since the vertical displacements of the true data generating process are less pronounced.

the SCE/Nash equilibrium level of inflation varies as β varies. This makes it inappropriate to choose a threshold value of π^* (or π) above which an escape begins. To avoid this problem, we define an escape in the γ_1 space, whose range of variation is not dependent on β.

Thus, we define an escape to begin when γ_1 is above γ_1^{in} $(-1 < \gamma_1^{in} < 0)$ and that escape to end when γ_1 drops below γ_1^{out} $(-1 < \gamma_1^{out} \leq \gamma_1^{in} < 0)$. By making $\gamma_1^{out} < \gamma_1^{in}$ we prevent the algorithm from counting "too many" escapes due to minor fluctuations in γ_1. In practice, we set $\gamma_1^{out} = -0.25$ and $\gamma_1^{in} = -0.20$.

[13] Note from (3.1) that both partial derivatives of π^* with respect to γ_0 and γ_1 tend to zero as $\beta \to \infty$.

As a result, escapes are less frequent.

3.2. Conservatism and the duration of escapes

In spite of the fact that more conservative policy makers are less prone to discover a "strong version" of the natural rate hypothesis, it might be supposed that once they escape Nash inflation their strong inflation aversion would make them more willing to sustain low inflation, i.e. to remain longer in the neighborhood of zero inflation. Instead, in addition to escaping less frequently, conservative central bankers also spend less time around the Ramsey outcome once they reach it. The third column of Table 1 reports the duration of an escape, measured by the number of periods during which the estimated unemployment-inflation tradeoff remains "almost zero" *provided* an escape has occurred.[14]

As β increases from $\beta = 0.2$ to $\beta = 4$ the escape duration decreases by a factor of 10. This effect reinforces and cumulates on top of the one concerning the frequency of escapes. Both effects make a period of almost-zero inflation implemented by a conservative policy maker (who mistakenly believes there is no unemployment-inflation tradeoff) a rare event. The combined result of these effects is reported in the fourth column of Table 4.1, which shows the number of periods in a simulation (given by the number of escapes times their duration) during which the policy maker measures a non-exploitable tradeoff as a ratio over the length of that simulation. When $\beta = 0.2$ the policymaker believes that γ_1 is near zero more than half of the times; the same event occurs less than 1 percent of the times for β greater than 4.

3.3. Conservatism and average inflation

We just showed that a conservative policy maker is both less likely to disinflate *all the way* to zero and less willing to sustain Ramsey inflation whenever he gets there. Thus, somewhat paradoxically, less conservative policy makers have a higher

[14] The duration is computed as follows: provided an escape has begun (i.e. that the estimated γ_1 climbs above the threshold value $\gamma_1^{in} = -0.2$), the algorithm counts for how many periods the estimated γ remains "near zero", i.e. above the threshold value $\gamma_1^{out} = -0.25$ (see footnote 12).

probability of implementing *near zero* inflation than more conservative policy makers. The latter, on the other hand, yield lower inflation rates under the Nash equilibrium, near which they float most of their time. Therefore, the last question we ask is whether these results are enough to deliver an average performance in terms of attained inflation (over a long period of time) that penalizes the conservative central banker.

Changes in the policymaker's aversion to inflation affect average inflation through three distinct channels: two were discussed in the previous two subsections; the third one, working in the opposite direction, is immediate from (3.1): a more conservative central banker chooses lower inflation rates (π^*). Figure 3 shows that this last effect dominates: a clearly negative correlation exists between the average inflation rate and central bank conservatism. This result indicates that average inflation is driven by the Nash inflation outcome (which is decreasing in β) despite the existence of (possibly) substantial deviations from that focal point. A conservative policy maker remains an effective way to bring inflation down, even in this model, and in spite of the fact that he will choose zero inflation less often than less conservative policy makers.

4. Concluding Remarks

A recent interpretation of inflation dynamics after World War II, first articulated by Sargent (1999), suggests that recurrent oscillations between high and low inflation may be produced by policy makers who ignore the expectational nature of the unemployment-inflation tradeoff. One feature which makes this interpretation appealing is that the empirical relation between unemployment and inflation remains an important one in policy discussions. This justifies doubting the idea that policy makers believe in the natural rate hypothesis. The interpretation flashes a warning about the potential inflation risks associated to such a policy behavior. Low inflation may occur when the data do not reveal an exploitable unemployment-inflation tradeoff, but such a situation is not bound to last.

The above warning deserves attention, particularly at a time when statistical Phillips-curve type relations seem to revive the interest of academics and policy makers.[15] We therefore examined its solidity without denying its premise, i.e. the ignorance of the expectational nature of the tradeoff. Rather, we adhere to the setup of Sargent (1999) and Cho, Williams and Sargent (2001) and construct a slightly more general version of their model, which allows different policy objectives to be considered.

In particular, in comparison to their analysis, our model allows one to analyze how different degrees of inflation aversion, on the part of the policy maker, affect the warning. Policy objectives are important because monetary authorities have historically shown different attitudes towards inflation. Moreover, monetary reforms in the recent past have made price stability the main policy objective of several central banks. Such reforms are indeed suggested as a cure to high inflation by standard economic theory in which the policy maker is assumed to know the structure of the economy (e.g. Rogoff, 1985). But what if the model is not properly specified? Would such reforms allow inflation to be controlled or not? To answer this question, we investigated how different inflation objectives affect the predictions of the conquest model.

Our results show that the statistical illusions to which policy makers succumb in the analysis of Sargent (1999) and Cho, Williams and Sargent (2001) are less likely to occur when policy makers are more inflation averse. This is due to the fact that conservative policy makers are less willing to move inflation away from target to reduce unemployment, even when the data suggest that such a policy is feasible. By generating much less variability in inflation, they annihilate the spark that triggers the escapes. Somewhat paradoxically this implies that less conservative policy makers, being relatively more prone to generate inflation variability, are more likely to hit zero inflation than conservative ones. But despite such episodes, which are infrequent and relatively short lived, the average inflation rate is lower for more conservative policy makers. This suggests that, even within the context of the conquest model, a conservative policy maker provides an effective way to reduce inflation and ensure that it is sustained.

[15] See the 1999 special issue of the Journal of Monetary Economics, "The Return of the Phillips Curve" edited by R.G. King and C.I. Plosser.

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Table 4.1: **Features of 'Escapes' as β varies**

β value	Frequency[a] (percentage ratio)	Duration of an escape[b] (number of periods)	% time believing that γ_1 is near zero
0.2	0.43 (.05)	138 (19)	58.7
0.5	0.24 (.04)	118 (18)	28.3
0.7	0.21 (.04)	119 (20)	24.0
1	0.20 (.04)	107 (20)	20.6
1.5	0.20 (.04)	83 (14)	16.3
2.0	0.20 (.04)	60 (11)	11.8
2.5	0.18 (.04)	40 (9)	7.0
3.0	0.13 (.04)	27 (8)	3.3
3.5	0.08 (.04)	18 (10)	1.4
4.0	0.05 (.04)	13 (10)	0.6
4.5	0.04 (.04)	11 (10)	0.3

Notes: Numbers in the table are averages calculated over 500 simulations for each value of beta (each simulation lasts 10,000 periods). Standard deviations are reported in parenthesis.
[a]The frequency of escapes is defined as the percentage ratio between the average number of escapes observed in a simulation and the total number of periods in that simulation (e.g. the frequency value 0.24, associated to beta=0.5, indicates that on average 24 escapes are observed over 10,000 periods in a simulation where beta=0.5).
[b]The duration of an escape is the average number of periods during which the estimated slope of the tradeoff remains greater than the threshold value -0.25 provided an escape has started (i.e. the estimated slope is greater than -0.20; see footnotes 12 and 14 for more details).

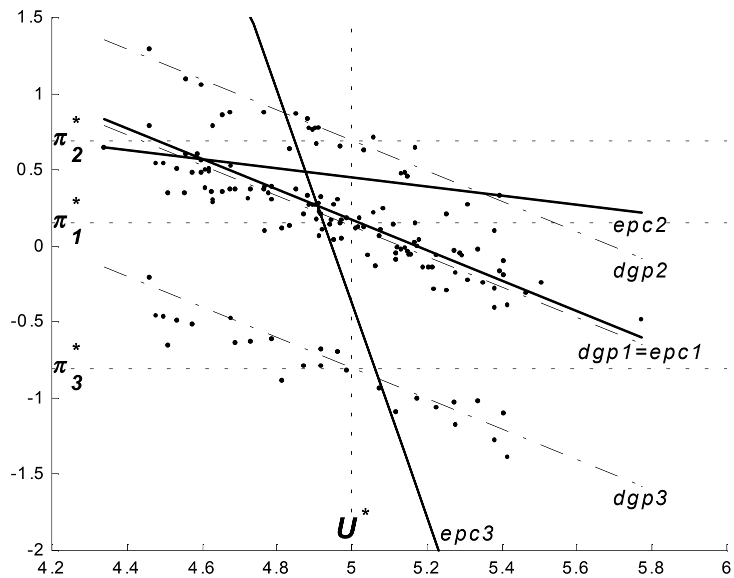

Figure 4.1: Ramsey Escapes

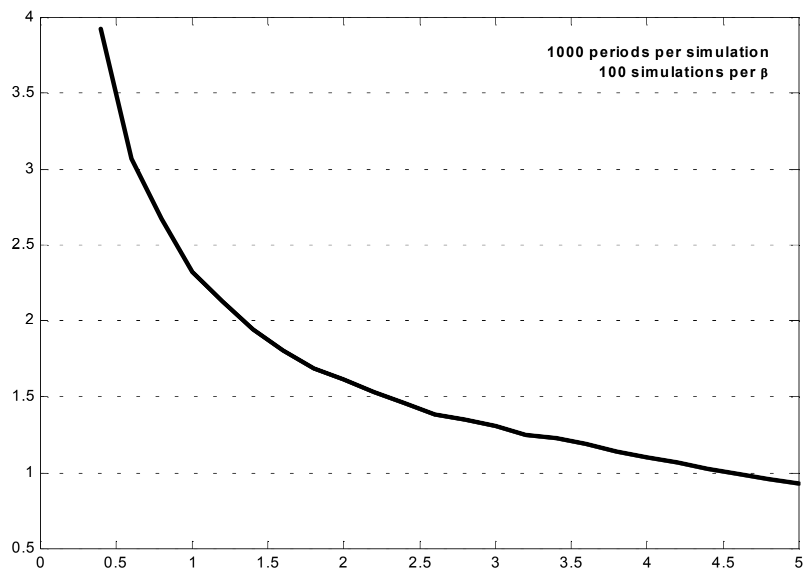

Figure 4.2: Average inflation as β varies