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NOTES ON CREDIBILITY AND STABILIZATION

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ABSTRACT

Do existing theories of stabilization help understand the credibility issues involved in such programs? The experience with stabilization in a hyperinflation setting in Israel and Latin America makes it worthwhile to ask how much existing theories help understand the success and failure of these experiments. Theories typically focus on interaction between policy makers and the public, with imperfect information about the true nature of the government and resulting games. But this model often does not help greatly in explaining stabilization. These notes raise some of the questions left unanswered by the traditional modelling of credibility.

The first sections deals with stabilization as a one-shot problem. This approach is used to ask what "credibility" might mean in a world where it is inconceivable that a program will succeed with probability 1. A model is spelled out where the equilibrium program has an ex ante probability of success. The model draws attention to the factors which raise or lower the probability of success of a stabilization program. The next section deals with the problem of waiting which is familiar from the option literature and recent international applications. It is shown here that in the immediate aftermath of stabilization there is a great difficulty in persuading the public to repatriate assets and engage in irreversible investment except at a large premium. But generating that premium is politically difficult.

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The experience with stabilization in a hyperinflation setting in Israel and Latin America makes it worthwhile to ask how much existing theories help understand the success and failure of these experiments. Many theories focus on interaction between policy makers and the public, with imperfect information about the true nature of the government and resulting games. But this model often does not seem to help greatly in explaining stabilization. Interest rates do not behave as if they were generated by this model and the very fact of stabilization has interesting aspects that are neglected in the reputation paradigm. These notes raise some of the questions left unanswered by the traditional modelling of credibility.

The first sections deals with stabilization as a one-shot problem. This approach is used to ask what "credibility" might mean in a world where it is inconceivable that a program will succeed with probability 1. A model is spelled out where the equilibrium program has an ex ante probability of success. The model draws attention to the factors which raise or lower the probability of success of a stabilization program. The next section deals with the problem of waiting which is familiar from the option literature and recent international applications. It is shown here that in the immediate aftermath of

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[1]These notes represent research in progress rather than completed work. I am indebted to Alberto Alesina, Peter Diamond, Avinash Dixit, Elhanan Helpman, Michael Mussa and Aaron Tornell for helpful suggestions.

stabilization there is a great difficulty in persuading the public to repatriate assets and engage in irreversible investment except at a large premium. But generating that premium is politically difficult.

1. A POSITIVE THEORY OF CREDIBILITY AND STABILIZATION

Sargent's work on the end of four big inflations made the term "credible" a household word.[2] Stabilizations which proved successful did so because they were credible. But Sargent did not offer a formal model of credibility nor did he consider other stabilization programs that had much the same features as the successful ones, but ultimately failed. In Dornbusch and Fischer (1986) we review a large number of stabilization attempts and conclude that slippage of fiscal policy is invariably the reason for a sliding back into high inflation.[3] But this subsequent deterioration often is not apparent at the outset of the program. By contrast, in several of the stabilizations that did succeed there was initially a serious lack of credibility, at least in so far as daily newspapers allow us to ascertain.

In Dornbusch (1987) I study public assessment of the German stabilization and conclude that rather than being an instantly recognized fact, stabilization only gradually became a success. But initially and for some months it continued to be viewed with great scepticism. Many of the budget reforms initially announced, in fact never took place. As another example, in 1924 Poincare attempted a stabilization in France and after a short period the

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[2]For a review of the credibility literature see Persson (1988).
[3]See,too, Webb (1988) who discusses the failed stabilizations in Germany preceding that of November 1923.

program failed. In 1926 Poincare tried again, undertook much the same measures and succeeded. Much of the uninformed discussion plays up Poincare as a "credible" policy maker and his program as one sure to succeed. But there is an obvious difficulty in reconciling the 1924 and 1926 experiences.

There is a more substantive point to be made about credibility: governments cannot, in fact, create facts that are set once and for ever, immutably. Any program can be undone (with more or less difficulty) by the next government. And this potential lack of persistence feeds back to the current policy actions required to make the program survive. Moreover, even a well-designed program may not be sturdy enough to withstand shocks such as a major, unexpected terms of trade deterioration. Thus credibility is a relative term and there is a need for a model of credibility.[4] A stabilization is ex ante more or less credible. We need a theory to capture how the public forms a judgment of this credibility and how that judgment possibly interacts with the credibility.

Broadly, stabilization fails for one of four reasons. The first is that a government is ignorant of economics. The program, although believed to be a good one, is demonstrably unsustainable. We have no theory of why governments might be ignorant and information costs (given the price of economics) is merely a way of covering this up. A second possibility which is

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[4]Research by Calvo (1987,88) focus precisely on this point. There is, of course, an ample literature on credibility in models of repeated games and reputation (See Persson (1988)), but their primary focus is on dynamics, learning and dissimulation. This may be an important complication of the stabilization problem. A first useful step is to highlight the issues that arise in a one-shot game as is done below.

central to the imperfect information-reputation literature on credibility resides in excessive doubts by the public about the policy maker's willingness to see the program through.

My interest is in the other two reasons for failure which arise from uncertainty about either the effectiveness of the program or about uncontrollable events (say export prices or world interest rates) which interact with the program and influence its success or failure. I will focus first on this latter uncertainty and develop a specific model.

A Model: Suppose, for concreteness, that we discuss a situation of exchange rate stabilization. We think of the problem as a one-shot game. The stabilization program is the solution to minimizing a loss function:

$$(1) \qquad L = (pK + \lambda A^2)/2$$

where p denotes the probability of program failure and A stands for adjustment effort. The government assigns a cost K to failure and hence pK is the expected cost of program failure. The second term measures the cost of adjustment. Adjustment means real wage cuts or real spending cuts and as such is politically costly.

The adjustment effort, A, is one of the determinants of the probability that the program will succeed. Once the adjustment effort is undertaken the private sector responds by deciding whether or not to undertake capital flight. The model is completed by a realization from the stochastic process that influences foreign exchange revenues. Our attention now focuses on the construction of the ex ante probability of program success or failure.

The probability of failure of a stabilization program is the result of an optimizing approach of the government which involves interdependence with the public's judgment of how successful stabilization will be. We start from a model in which there are no capital flows and only later introduce this complication. The program fails if net foreign exchange disbursements, F, exceed available reserves, R.

(2) $$F = x - \alpha A > R$$

Net foreign exchange disbursements have two components. There is a random component, x, and there is also the component that depends on adjustment effort (the real exchange rate). The more substantial the adjustment effort, other things equal, the smaller expected net disbursements. Specifically, a real depreciation (an increase in A) would reduce the trade deficit and hence the foreign exchange drain.

The probability of failure is the probability of net foreign exchange disbursements in excess of reserve holdings:

(3) $$p = p(x>R+\alpha A)$$

At this stage we can assume a particular distribution to calculate a closed form expression for p. An alternative route is to employ Tchebycheff's inequality which yields an upper bound on the probability of program failure:[5]

(4) $$p\ (x>R+\alpha A) = \sigma^2/(R+\alpha A)^2$$

where σ^2 is the variance of x.

The government minimizes the loss function subject to (4). The first order condition then is:

(5) $$\lambda A = \alpha K\sigma^2/(\alpha A+R)^3$$

Figure 1 illustrates the solution. The marginal cost of adjustment (MC) is proportional to the level of adjustment effort, λA. The coefficient λ is the parameter determining the marginal cost of adjustment. The marginal benefit $MB=\alpha\sigma^2K/(\alpha A+R)^3$ deriving from the reduction in the expected cost of program failure is shown by the downward sloping schedule.

The equilibrium adjustment effort is denoted by A*:

(6) $$A^*=A^*(R,\alpha,\sigma,\lambda,K)$$

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[5]From the inequality $p(x>k\sigma)\leq 1/k2$ with σ the standard deviation of the zero mean distribution of x, let $k\sigma=\alpha A+R$ to obtain the upper bound on the probability shown in the text.

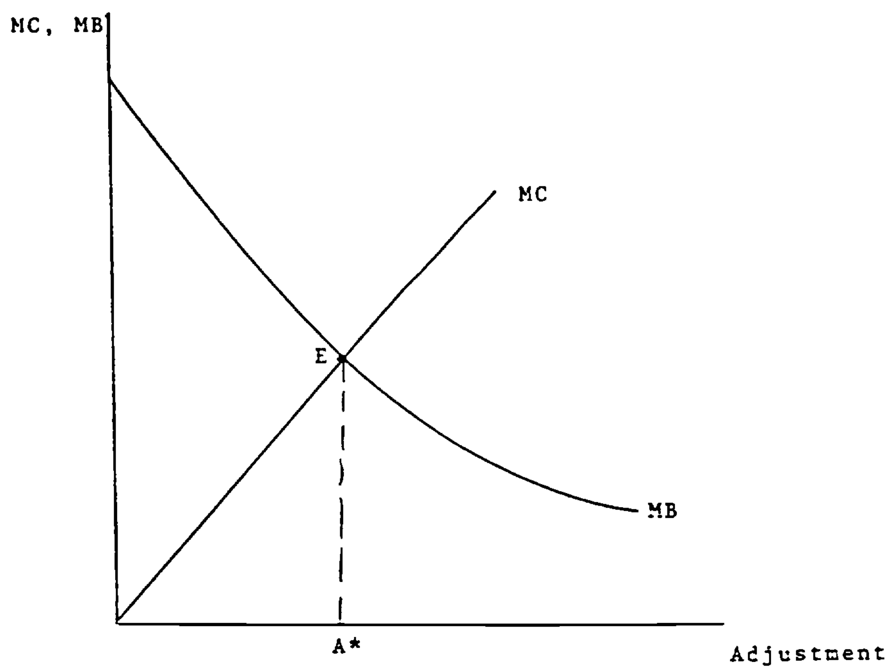

Figure 1

and, from substitution in (3) there is a corresponding equilibrium probability of program failure:

(7) $$p^* = p^*(\alpha, \lambda, \sigma, R, K,)$$

The next step is to enquire what are the properties of this probability. To fix ideas we use the case of a symmetric uniform distribution with maximum realizations of x denoted by m.[6] In that case the probability of program failure as a function of adjustment effort is:

(3a) $$p = (m - R - \alpha A)/2m$$

To derive the comparative static properties it is helpful to focus on Figure 2 which shows iso-cost curves corresponding to eq. (1) as well as the probability schedule corresponding to (3a). The optimal choice of adjustment effort and the corresponding equilibrium probability of program failure are shown by point E.

The optimal adjustment effort becomes:

(6a) $$A^* = \alpha K/4\lambda m$$

and the resulting optimal probability of program failure becomes:

(7a) $$p^* = (1 - R/m)/2 - \alpha^2 K/8\lambda m^2$$

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[6]We concentrate on the case where m>R.

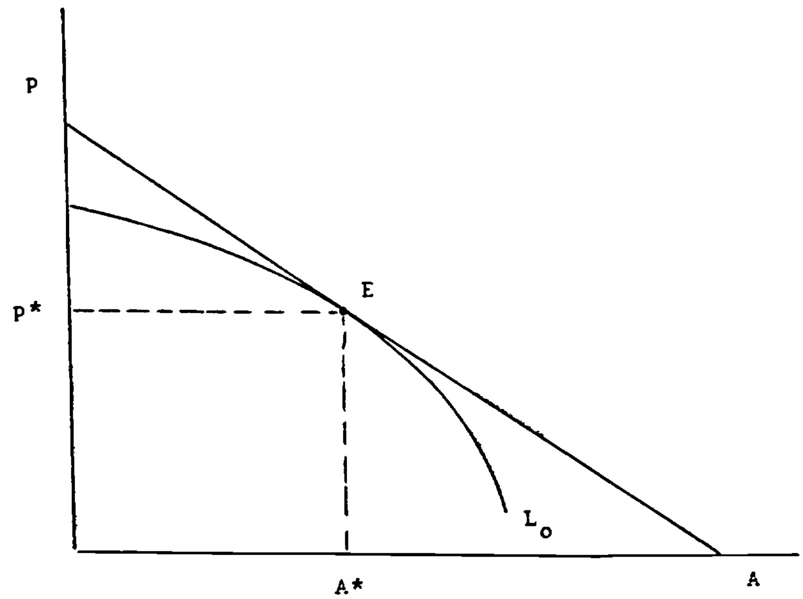

Figure 2

A shift in R, σ or α will affect the probability schedule while changes in λ or K affect the iso-loss loci. Using the diagram or equations (7a) it is straight forward to derive the following properties.

• Program failure is less likely the higher the initial stock of reserves, R. This point draws attention to the role of foreign loans in stabilization programs. Austria in the 1920s benefited from League of Nations Loans and Israel in its stabilization could call on US aid. In much the same way Bolivia announced suspension of external debt service which amounted to a self-administered external loan. In the literature on stabilization foreign loans are discussed as the sine qua non. In the present model they do play a role because they are a substitute for adjustment.

• A higher marginal cost of adjustment (a larger λ) implies a higher probability of program failure. In societies that are politically highly polarized adjustment is much more costly. As a result adjustment effort will be less and hence the probability of program failure will be larger. The coefficient λ could be interpreted in terms of the scope for cooperation between unions and the government: in Israel and Mexico such cooperation is possible and important, in Argentina it is excluded. Alesina (1988), Eichengreen (1988) and Dornbusch (1985) have emphasized the political costs in polarized societies of undertaking adjustment programs.

• A higher responsiveness of the trade balance to adjustment effort implies a larger optimal adjustment effort and hence a reduced probability of failure. This responsiveness can be interpreted as the extent to which an economy is open or closed. An open economies can achieve major trade improvements with relatively small real depreciation. Very closed economies have to achieve larger depreciation or expenditure cuts.

- Countries with a more volatile external balance, in the sense of σ, will make larger adjustment efforts. But the larger adjustment effort does not translate into a reduced probability of failure.

- The higher the cost of program failure, K, the larger the adjustment effort and the lower the probability of failure. One might conjecture that in a situation where there have been many previous failures the costs in terms of prestige or politics are small. Hence the investment in stabilization will be small and, in a self-fulfilling way, most programs will fail except if they were to experience unusually favorable (unexpected) conditions.

These predictions make up a positive theory of adjustment. The testing involves a cross section of stabilization programs where the characteristics of countries $(R,\alpha,\lambda,\sigma,K)$ are used to determine their a priori probability of success.

Capital Flight: The most immediate extension is to consider a role for capital flows. Specifically assume that private capital flight will depend on the probability of program failure anticipated by the public which we denote by p'. Our criterion for the probability of program failure now becomes:

$$(8) \qquad p = p(x > R + \alpha A - \beta p')$$

where β measures the response of capital flight to the perceived probability of failure. We consider first the case where the government selects its adjustment effort, followed then by the capital flight decision of the public before the realization of the trade shocks is seen. In this case a Stackelberg solution is appropriate. The government recognizes that the public will evaluate the adjustment effort in the same way the government does and hence arrive at the same estimate of the probability of success. We therefore immediately set p=p' in (5). Now Tchebycheff's inequality yields a more complicated relation for the probability of failure, namely:

(9) $$R + \alpha A - \beta p = \sigma/\sqrt{p}$$

The solution for the probability is a cubic the analytical solution to which is not very helpful. From Figure 3 where we plot the left (LH) and right hand side (RH) of the equation it is apparent that now there is a possibility of multiple equilibria. But in the Stackelberg case this is not a problem since the public will assume that the government will select among the two possible solutions the adjustment effort which represents yields minimum cost.

We can once again look at the case of a uniform distribution which yields as the equilibrium failure probability:[7]

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[7]We assume that $2m>\beta$ and $m>R$.

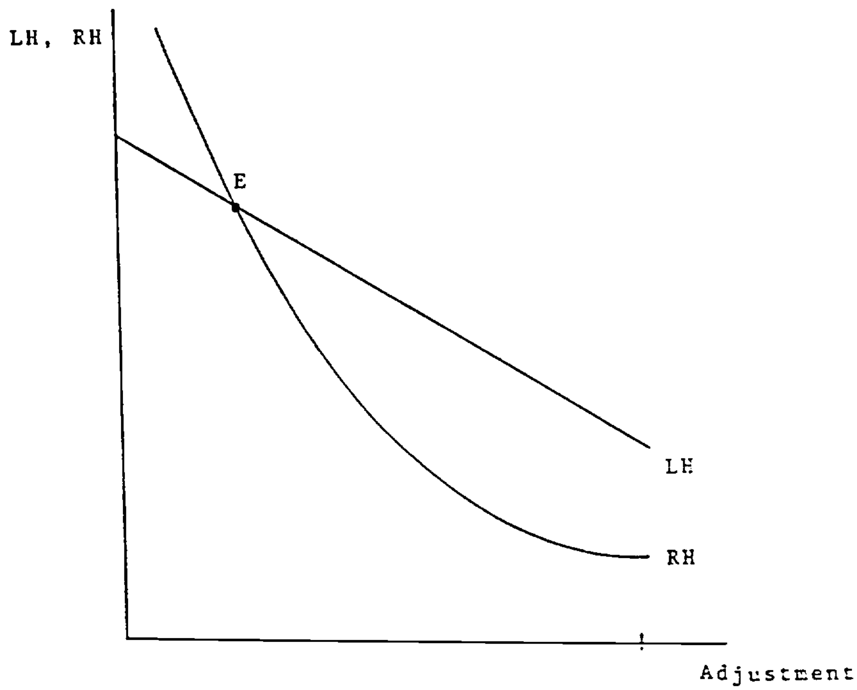

Figure 3

(7b) $p^* = (1-R/m)/(2-\beta/m) - \alpha^2K/2\lambda(2m-\beta)^2$

It is readily verified that this expression is an increasing function of β. Increased capital leads to a larger adjustment effort but even so brings with it an increased probability of program failure.

Nash Equilibrium: In our analysis above the Stackelberg solution was appropriate since the public decides on capital flight only after the government selects the adjustment effort. But if the capital flight decision were to be made concurrently with the government's choice of the adjustment effort a Nash equilibrium is also a plausible solution.

Now the government finds the optimal adjustment effort for a given p'. Then the rational expectations assumption $p=p'$ is imposed on the solution. The resulting expression for the equilbrium probability of program failure is:

(7c) $p^* = (1-R/m)/(2-\beta/m) - \alpha^2K/\lambda(2m-\beta)$

Comparison with (7a) readily reveals that in the Nash case, because the government does not internalize at the optimization stage the effects of adjustment on capital flight, adjustment effort is less and the probability of program failure is higher.

<u>Extensions</u>: There is a number of directions in which the model can useful;y be extended.

• Rather than assuming that capital flight takes the simple form βp, a more appropriate model involves the expected interest differential adjusted for exchange losses. Thus the capital flight component, ϵ, rather than being βp becomes:

$$(10) \qquad \epsilon = \beta[i^* - (1-p)i - p\Delta]$$

where i and i* are the home and foreign interest rates and Δ is the percentage loss suffered in case of program failure. This will typically be an exchange loss. In this extended model interest rates and the extent of exchange loss under program failure become additional determinants of the ex ante probability of failure.

• The kind of uncertainty. Rather than focusing on the program parts, we can look at uncertainty about key parameters in the optimal stabilization. Specifically, there might be uncertainty about the coefficient α which links adjustment effort to trade performance. There might also be uncertainty about the costs of stabilization so that the coefficient λ is random. This multiplier uncertainty is important because, unlike in the model developed above, the government's adjustment effort will influence the variance of foreign exchange flows.

• Modelling stabilization as a two-period problem. In the first period the government undertakes stabilization, (followed by capital flight or not) and the realization of stochastic shocks. Then, using the accumulated information prior to a second period, the government makes "readjustments" in its stabilization program. This modelling would be particularly useful if we deal with uncertainty regarding the effectiveness of programs. It also applies if in fact the public doubts that the government will in fact carry out the program as initially announced.

• The model has been developed in terms of an exchange rate stabilization problem. But the approach is obviously more general. Specifically it should be possible to express a theory of fiscal and inflation stabilization in these terms.

2. WAITING

A common problem in the aftermath of stabilization is the lack of a stabilizing capital reflow. Investors have an option to postpone the return of flight capital and they will wait until the frontloading of returns is sufficient to compensate for the risk of relinquishing the liquidity option of a wait-and-see position. This is the case even when interest rates are high and rewarding. Moreover, when capital does return it chooses a highly liquid form, sitting so to speak in the parking lot, with the engine running. There is definitely little commitment to a rapid resumption of real investment. The reason for this is residual uncertainty whether stabilization can in fact be sustained.

In the literature this topic has been addressed in a number of ways, mostly in terms of irreversible investment decisions.[8] We concentrate

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[8]See, for example, van Wijnbergen (1985), Bodin and Serven (1986), Reynoso (1988).

here on a very simple two-period example to make the basic point. Suppose that investors have the choice between investing in the US or in Mexico. The return in the US in both periods is R^*-(1+r*). In Mexico the first period certain return is R^*+m. In the second period, with probability p events are good and the return is R^G. With probability (1-p) they are bad and the return is only R^B.

The question now is how much of a first period premium is required to induce investors to accept the uncertainty and invest immediately for two periods. We assume that investors have the choice to postpone the decision to invest until the uncertainty is resolved; they cannot, however, disinvest in Mexico after the first period, upon finding out that a bad state has materialized. The decision then is to invest now or to wait until uncertainty is resolved.

Table 1 Expected Investment Returns

	1st Period	2nd Period
Invest in Mexico Now Irreversibly	$R^* + m$	$pR^G + (1-p)R^B$
Wait and See	R^*	$pR^G + (1-p)R^*$

To sharpen the point we assume that the expected return in the second period is equal to the US return, that is $R^* = pR^G + (1-p)R^B$. The relevant criterion for immediate investment in Mexico then is:

$$(11) \qquad (R^{*}+m)[pR^{G} + (1-p)R^{B}] > R^{*}[pR^{G} + (1-p)R^{*}]$$

which, noting that $R^{*}=pR^{G} + (1-p)R^{B}$, this expression reduces to

$$(12) \qquad m \geq (1-p)(R^{*} - R^{B})$$

Thus a risk neutral investor requires a premium to make an investment which has the same second period expected return (R^{*}) as his alternative investment opportunity. The reason is that with waiting an even higher return can be achieved, once uncertainty is resolved (or narrowed down). The premium required for immediate investment is higher the larger is the probability of a bad state and the larger is the discrepancy between the foreign rate of return and that prevailing in an adverse state.

But how can governments reassure investors? The common answer is to bring about a "credible" stabilization. In practice it comes down to high interest rates and an exchange rate so competitive that expected further depreciation is unlikely. But high interest rates are counterproductive from a point of view of growth because they lead to holding of paper assets rather than real investment. A low real exchange rate cuts the standard of living and thus reduces domestic demand and profitability for all investments except in the traded goods sector.

But if real depreciation is not sufficient to bring about investment the government faces a very awkward position: income is being redistributed from labor to capital, but because the real depreciation is not sufficient (in terms of (12)), the increased profits are taken out as capital flight. Labor will obviously insist then that the policy be reversed. This uncertainty is an important feature in understanding the real exchange rate - capital flight relationships and the post-stabilization difficulties in developing countries and the stabilization experience of the 1920s.

Extensions: The model as set out misses one important point. The Wait-and-see strategy may forego capital gains which go to those who invest early. Therefore the criterion in (12) may be overly stringent. Of course, that need not be the case since in bad outcomes there will be capital losses and these act as a deterrent to early investment. On balance therefore the capital gain issue may not create a bias either way.

The model can be taken in two directions. One is to develop an extension that fleshes out the good and bad states in terms of a more complete model of the economy. Specifically it is important to model the relationship between real wages and the profitability of capital. If this model is to be used to explain the reluctance to invest in real assets in a precarious country then the returns must be linked to factor costs and exchange rates. Such a model brings out the adjustment costs required to bring in direct investment.

The other direction of research is to explore with this model the actual pattern of capital return: how rapidly do financial flows reverse themselves and how long does it take before investment in real assets resumes.

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