Inflation Targeting and Debt Crises in the Open Economy: A Note

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1. Introduction

First, I would like to express my gratitude to Alexander Swoboda and Charles Wyplosz for inviting me at this conference. I have known Alexander for less time than most participants: the first time we met was about 10 years ago when he came to the Research Department of the IMF—a few years after the defense of my thesis, which had been supervised by Charles. Alexander and I collaborated, together with Jeromin Zettelmeyer and Michael Mussa, on an all-encompassing paper on reforming the international financial architecture (Mussa et al, 2000). This paper had a big impact—on me at least, since I am still working on the questions that we discussed at that time.

This short paper is also related to international financial architecture, namely a certain new "conventional wisdom" about the appropriate exchange rate regimes for developing countries. At the risk of oversimplifying, I would define its core elements as: (1) inflation targeting is the best nominal anchor for an autonomous monetary policy; (2) however, some countries may prefer to adopt the currency of another country rather than developing an inflation-targeting regime of their own.

This view is consistent with the "polar" or "corner" view of exchange rate regimes, to which Alexander Swoboda was an early contributor (Swoboda, 1986; Eichengreen, 1994; Fischer, 2008). But the new conventional wisdom goes further than simply emphasizing the inherent fragility of fixed but adjustable exchange rate peg in a world of capital mobility: it also outlines a long-run future for the international monetary system, as a set of inflation-targeting currency areas linked to each other by floating exchange rates. It is not even clear that the

world needs coordination mechanisms or institutions to manage such a "system", to the extent that the gains from international monetary coordination are small or difficult to achieve (Rose, 2007).

I am going to cast a somewhat critical look on this "new conventional wisdom", but before I do so, let me clarify beforehand that this paper is not meant as a defense of old-style fixed currency pegs. Fixed but adjustable currency pegs have demonstrated their instability and macro-financial costs in many occasions. By contrast, floating exchange rate *cum* inflation-targeting regimes have so far largely fulfilled the expectations of their proponents. They are more stable than fixed pegs, and they have produced better macroeconomic outcomes in the emerging markets countries that have adopted them (Rose, 2007).

But I think that there are issues related to financial stability that are left unresolved by the inflation targeting paradigm (as it stands).[1] In this paper I argue that when there is a risk of systemic debt crisis, "flexible inflation targeting"[2] may have implications that seem different from what is usually understood by inflation targeting. I also argue that even in a world composed of inflation-targeting currency areas, international cooperation can play a useful role in insuring countries against financial shocks, so that there remains scope for multilateralism in managing international monetary and financial matters. My arguments are based on a very simple model, to which I now turn.

2. Model

I consider a small open economy in which excessive debt can lead to widespread bankruptcies and a loss of output. Domestic monetary policy can help the domestic economy by inflating away some of the debts (assumed to be denominated in domestic currency).

For simplicity, I assume that there are only two periods (*t=1,2*) and one good. The law of one price applies,

$$P_t = S_t + \varepsilon_t , \qquad (1)$$

where S_t is the exchange rate at time *t* (the price of domestic currency in terms of foreign currency) and ε_t is a noise term. In this simple one-good model, ε_t could be interpreted as a

[1] Charles Goodhart develops a similar theme in this volume. Kumhof et al (2007) show that inflation-targeting regimes may be vulnerable to speculative attacks when there is fiscal dominance and fiscal policy is inconsistent with the inflation target. See also Bordo and Jeanne (2002) for an analysis of the dilemmas faced by monetary policy-makers in credit boom/bust episodes that is closely related to the one in this paper.

[2] As defined by Lars Svensson, i.e., as a targeting rule that maximizes an explicit objective function capturing concerns about the real economy in addition to inflation. See Svensson (2000) for an analysis of flexible inflation targeting in a small open economy.

shock to the foreign price level or to trading costs, but in a more general multi-goods model it could be interpreted as a shock to the real exchange rate.

Domestic agents have the following utility,

$$u(c,\pi) = c - a\ \pi^2, \qquad (2)$$

where c is period-2 consumption, π is the inflation rate between 1 and 2, and parameter a is the domestic aversion to inflation. The aversion of domestic agents to inflation is simply assumed (it is not micro-founded). The desired inflation rate is normalized to zero without restriction of generality. One question that we will look at is whether there is a case for delegating monetary policy to a conservative central banker who is more averse to inflation than the population.

There are two types of domestic agents: entrepreneurs and investors. Entrepreneurs have an investment opportunity in period 1, which they finance by borrowing from investors. For simplicity I assume that there is one investor per entrepreneur. Total population is normalized to 1, so aggregate and per capita variables will be the same.

Each entrepreneur can make an indivisible investment k in period 1 which yields,

$$y = Ak, \qquad (3)$$

in period 2, where the level of productivity, A, is stochastic. I assume, for simplicity, that A can take two values. Productivity is normally high, $A = A_H > 1$, but with probability p it could be low, $A_L < 1$. The world riskless interest rate is normalized to zero, and the domestic investment opportunities are profitable ex ante ($E(A) = (1-p)A_H + pA_L > 1$). Productivity is perfectly correlated across entrepreneurs, so that a shock to A is an aggregate shock.

Entrepreneurs have no funds in period 1, implying that each entrepreneur must borrow k. I assume that each domestic investor is endowed with $w = k$ so that there is no need for capital inflows to finance domestic investment. The case with capital inflows introduces complications that are interesting but not necessary to make the main points of this paper.[3] Thus, in period 1, each domestic investor lends k to each domestic entrepreneur.

The entrepreneur promises to repay $d = Rk$ in domestic currency to the investor. Note that debt is nominal: the repayment is specified in terms of domestic currency. The value of the domestic currency is set by the domestic central bank. The period-1 nominal price is

[3] These complications come from the fact that the domestic government may be tempted to expropriate foreign holders of domestic currency debt through inflation. The consequences of this have been discussed elsewhere (see, e.g., Tirole, 2002). In particular, foreign creditors may protect themselves from expropriation by denominating their claims in foreign currency, leading to liability dollarization. Of course, dollarization reduces the country's ability to resolve a debt crisis by domestic inflation.

irrelevant and normalized to 1. Thus, the period-2 nominal price is equal to 1 plus the inflation rate ($P_2 = 1 + \pi$). The central bank sets π in period 2.

The lending relationship is affected by a friction a la Townsend (1979). If the entrepreneur is insolvent ($P_2 y < d$) then there is a bankruptcy in which the creditor recovers $y - \gamma$, where γ is the deadweight cost of a bankruptcy. The entrepreneur recovers nothing in a bankruptcy. Thus, the equilibrium gross interest rate on the debt, R , includes premia for the risks of inflation and default.

A systemic default occurs when the representative entrepreneur is insolvent, that is if $P_2 y < d$. Using $P_2 = 1 + \pi$, $y = Ak$ and $d = Rk$, this condition can be rewritten

$$\pi \leq \pi^*(A),$$

where the threshold $\pi^*(A)$ is defined by,

$$\pi^*(A) = \frac{R}{A} - 1. \qquad (4)$$

The threshold $\pi^*(A)$ is the minimum level of inflation to avoid a systemic default. If $A_L < R < A_H$ (which is true in equilibrium, as shown in the appendix), then

$$\pi^*(A_H) < 0 < \pi^*(A_L). \qquad (5)$$

This means that if productivity is high the central bank can set the inflation rate at the desired level (zero) at no cost in terms of output. But if productivity is low, the central bank must raise the inflation rate above the desired level in order to avoid a systemic default.

The central bank sets the inflation rate so as to maximize an objective function. For example, it could maximize domestic welfare, defined as the sum of the utilities of domestic investors and entrepreneurs. It is easy to see that domestic welfare is a linear-quadratic function of output per capita and inflation,

$$U = y - a\pi^2. \qquad (6)$$

Expression (6) is obtained by summing up $u(c, \pi)$ across domestic investors and entrepreneurs and using the fact that period-2 aggregate consumption is equal to aggregate output (since the country does not borrow or lend abroad in period 1).

Note that (6) is the same type of objective function as in Barro and Gordon's (1983) seminal paper about the time inconsistency problem in monetary policy. The difference with the Barro-Gordon model is that output is influenced by inflation through a financial friction rather than through nominal stickiness. Inflation can increase output, following a bad productivity shock, by avoiding a systemic default.

[Insert Figure 1]

The aggregate supply schedule is shown in Figure 1. Note that the impact of inflation on supply is highly non-linear. If productivity is low and there is a systemic debt crisis, the central bank must raise the inflation rate above a critical threshold in order to have a real impact on the economy. Increasing the inflation rate marginally above the desired level has no effect. This non-linearity implies that the central bank must choose between two corner solutions in a systemic debt crisis: one with high inflation and high output, and one with low inflation and low output.

3. Inflation targeting and debt crises

Before proceeding with a discussion of exchange rate regimes, I would like to digress a little on what this model has to say about inflation targeting. The equilibrium of the model is derived in the appendix under the assumption that the central bank maximizes domestic welfare (6). As suggested by the discussion above, the central bank's policy reaction function is to implement zero inflation if productivity is high, and a positive rate of inflation (to avoid generalized default) if productivity is low:

$$\begin{cases} \pi = 0 & \text{if } A = A_H, \\ \pi = \pi^*(A_L) > 0 & \text{if } A = A_L. \end{cases} \qquad (7)$$

This is the optimal policy reaction if the central bank cares sufficiently about output relative to inflation, i.e., if the risk aversion parameter *a* is not too high relative to the output cost of systemic bankruptcy:

$$a\pi^*(A_L)^2 < \gamma . \qquad (8)$$

An interesting feature of this model is that, unlike the Barro-Gordon model, it does not give rise to a time consistency problem. If the policy reaction function (7) is optimal ex post, then it is also the optimal policy rule ex ante. Thus, there is no reason, in this model, to delegate monetary policy-making to a conservative central banker à la Rogoff (1985) who is more averse to inflation than the population. [4] Doing so would generate a downward bias in inflation: the conservative central banker will tend to be insufficiently responsive to systemic credit crises, even from an ex ante perspective.

How does the policy reaction function (7) compare with an inflation targeting regime? It is obviously different from *strict* inflation targeting, which would imply that the inflation rate is maintained at zero no matter what happens to output. However, this policy reaction can be

[4] As shown in the appendix, there is one caveat to this statement. The commitment to a policy rule may help eliminate a bad equilibrium in which a high probability of debt crisis is self-fulfilling.

interpreted as *flexible* inflation targeting as defined by Svensson. The policy reaction function (7) is exactly what one gets if the central bank announces a target inflation rate of zero, allowing for deviations from the target to accommodate concerns about output captured by the objective function (6). And as I argued above, this objective function is the appropriate one, given that there is no reason for the monetary policy-maker to be more conservative than the population.

Flexible inflation targeting thus implies, in this model, that the central bank envisage to tolerate a rate of inflation substantially higher than the target in a systemic credit crisis. Furthermore, the central bank should choose between high inflation and low output based on the preferences of the population, not that of a conservative central banker. This sounds rather different (to me) from the way that most central bankers think of inflation targeting.

Obviously, the model is simplistic and misses important costs of inflation. First, the reputational costs of inflation are not taken into account. This raises the question of how the central bank can make clear that a temporary increase in inflation in response to a debt crisis does not mean that the inflation target is abandoned in the long run. Second, the model does not take into account the moral hazard (or other distortions) that may be generated by the fact that the central bank effectively insures firms against the consequences of bad productivity shocks.[5] The broader point, however, carries through: in a systemic debt crisis, a regime of flexible inflation targeting (properly understood) might put more weight on output stabilization and less weight on inflation than one might think.

4. Exchange rate regimes: the polar view

What are the implications of the model for exchange rates and exchange rate regimes? Using (1) and $P_2 = 1 + \pi$, the second-period exchange rate is given by,

$$S_2 = 1 + \pi - \varepsilon_2.$$

Thus, under **flexible inflation targeting** the exchange rate is floating for two reasons: because of the shocks to the law of one price (ε_2), and because the exchange rate depreciates in a debt crisis resolved by high inflation ($\pi > 0$). Using (6) ex ante domestic welfare is given by,

[5] Those distortions are discussed in Jeanne (2008). To the extent that the insurance does not involve an ex post transfer from a third party (but a transfer between the contracting parties), it does not create moral hazard *stricto sensu*. However, the insurance involves an externality that may lead to excessive inflation and inefficient herding in investment. As I argue in my other paper, those distortions are difficult to address in the context of a narrowly defined inflation targeting framework (i.e., in which interest rate setting is not augmented by other policy instruments).

$$U^{float} = U^{fb} - pa\pi^*(A_L)^2, \qquad (9)$$

where $U^{fb} = E(A)k$ is the first-best level of welfare, i.e., the expected level of output if there is no risk of default.

One can compare the floating regime with the following two regimes,

Full dollarization. Then $S_2 = 1$, which implies

$$\pi = \varepsilon_2 .$$

Inflation is low, but variable, and in a way that is it is dictated by foreign conditions. This regime does not offer any insurance against a debt crisis if ε_2 is uncorrelated with A. Domestic welfare is given by,

$$U^{dol} = U^{fb} - p\gamma - aVar(\varepsilon). \qquad (10)$$

Fixed peg with escape clause. This regime is a combination of the previous two ones. The fixed peg $S_2 = 1$ is maintained if productivity is high, and the currency is depreciated to the level ensuring no default if productivity is low. The advantage of this regime, relative to dollarization, is that the exchange rate can be depreciated in response to a large negative productivity shock. Then there is no deadweight loss of output, but the inflation rate is still excessively variable.

$$U^{fix} = U^{fb} - pa\pi^*(A_L)^2 - (1-p)aVar(\varepsilon). \qquad (11)$$

Using (8), (9), (10) and (11), it is easy to see that there is a strict Pareto ranking between the three regimes,

$$U^{float} > U^{fix} > U^{dol}.$$

This ranking simply reflects the benefits of flexibility. Inflation targeting with floating dominates the other two regimes, and a fixed peg with an escape clause is better than full dollarization.

However, the ranking might be different if the credibility of the regimes were less than perfect. To see this, let us assume that the announced regime is implemented with probability μ (the credibility of the regime). With probability $1-\mu$ the monetary authorities implement a stochastic rate of inflation that is uncorrelated with A. By construction, dollarization is irreversible and so it is perfectly credible ($\mu^{dol} = 1$). But the same is not true for the other two regimes. In the limit where credibility is equal to zero ($\mu = 0$), those regimes compound variable inflation with a high risk of systemic default.

[Insert Figure 2]

Figure 2 shows how domestic welfare depends on the level of credibility under the different regimes. For low credibility, full dollarization dominates and the reason is precisely that this regime is completely credible. By contrast, for a given sufficiently high level of credibility inflation targeting dominates. The interesting point is that the intermediate regime (currency peg with escape clause) is always dominated by one of the other two regimes. Thus the country should either float or dollarize, never peg, which is the polar view.

One might argue that the comparison is unfair, because it assumes the same level of credibility for inflation targeting as for the fixed peg. One view is that a floating exchange rate is intrinsically less credible because it does not offer the same clear nominal anchor as a fixed peg, that is[6]

$$\mu^{float} < \mu^{fix} .$$

In terms of Figure 2, thus, the appropriate comparison should be between B and A', rather than B and A, so that a fixed peg could dominate floating.

However this argument is not very convincing from a theoretical or an empirical point of view. First, one might argue that floating (cum inflation targeting) is intrinsically more credible than a fixed peg precisely because it yields a higher level of welfare—and so is less costly to maintain—for any given level of credibility.[7] Second, the evidence suggests that an inflation targeting regime does a reasonably good job of providing a credible nominal anchor, even in developing countries with a recent history of monetary instability. This is not to say that inflation targeting cannot be vulnerable to the same kind of vicious circles (in which low credibility feeds on itself in a self-fulfilling way) as fixed pegs. But both theory and experience suggest that they are less prone to those problems.

5. International financial insurance

As a way of concluding this paper, I would like to question Rose's (2007) idea that international cooperation becomes much less relevant in a world where all countries target inflation and let their exchange rates float. My point will be that even in such a world, there is scope for cooperation to enhance financial stability, and this has implications for exchange rates.

Assume that a number of countries like the one described above have established perfectly credible inflation targeting regimes (Rose's end of history). Then the ex ante welfare of each

[6] See Calvo and Reinhart (2000) for a discussion of various problems posed by floating exchange rates in emerging market countries.

[7] This would be the prediction of an escape-clause model with an optimizing policymaker (aka "second-generation" model of currency crisis) of the type reviewed by Jeanne (2000).

country would be given by U^{it}, which is the highest level of welfare we have seen so far. Isn't it possible to do better?

The answer is yes, if the productivity risk is diversifiable across countries. Then the welfare of each country could be increased to the first-best level by a crisis insurance mechanism that transfers resources from high-productivity countries to low-productivity countries.[8]

To keep things simple, let us assume that the productivity risk is perfectly diversifiable across countries. Then a fraction p of the countries have low productivity and each one of these countries receives a transfer θ from high-productivity countries. The transfer costs $\frac{p}{1-p}\theta$ to each high-productivity country. Since $E(A) > 1$, it is possible to find a level of θ such that the entrepreneurs in all countries are solvent, i.e.

$$A_L k + \theta \geq 1,$$

$$A_H k - \frac{p}{1-p}\theta \geq 1.$$

With such an arrangement, all entrepreneurs are guaranteed their expected level of productivity and there is no risk of systemic bankruptcy. Monetary policy, being relieved from the burden of dealing with financial instability, can focus on strict inflation targeting (leading to more stable exchange rates). Hence, the first-best level of welfare, U^{fb}, is achieved by all countries.

This is, again, a simplistic piece of analysis. I am glossing over important issues, such as moral hazard. But I think that there is a more general theme behind this simplistic example. A lot is asked from monetary policy, especially in times of financial instability, and there might be a scarcity of policy instruments relative to the number of objectives—a point also made by Charles Goodhart in this volume. This is not a weakness of inflation targeting relative other monetary regimes, but this is certainly a critique of the idea that the inflation targeting framework resolves all the main issues faced by monetary policy-makers. There is a need for thinking of monetary policy in the context of a wider framework that also includes financial stability in its objectives. The point that I am trying to conclude with, is that such a framework might have a strong international, multilateral dimension.

[8] Alternatively, the countries could establish in period 1 a Fund that bails out the entrepreneurs of the countries that have low productivity in period 2. Although this may be reminiscent of an institution such as the IMF, it is important to keep in mind that the IMF operates under different rules (it lends, does not make transfers; and its lending should be motivated by some balance-of-payments problems rather than domestic financial crises). An analysis of how the IMF can help in the context of my model requires a slightly more involved analysis.

Appendix

The purpose of this appendix is to characterize the equilibriums of the model, and to prove the statements made in the text. We first consider a discretionary equilibrium in which the central bank solves for the optimal inflation rate ex post (in period 2). The equilibrium gross interest rate R^* must solve the following fixed-point problem. Given R and A, the optimal policy reaction function $\pi(R,A)$ is the level of inflation that maximizes domestic welfare (6) subject to the supply schedule. Then R^* must satisfy the zero-profit condition of lenders which, using $P_2 = 1+\pi$, $y = Ak$, and $d = Rk$, can be written,

$$1 = E\left[(1-\delta(R,A))\frac{R}{1+\pi(R,A)} + \delta(R,A)\left(A - \frac{\gamma}{k}\right)\right], \qquad (12)$$

where $\delta(R,A)$ is the dummy variable for a systemic default (equal to 1 if $\pi(R,A) < R/A - 1$, and to zero if not).

The policy reaction function $\pi(R,A)$ maximizes $U = y - a\pi^2$ subject to the supply schedule

$$\begin{cases} y = Ak & \text{if } \pi \geq \pi^*(A) = R/A - 1, \\ y = Ak - \gamma & \text{if } \pi < \pi^*(A), \end{cases}$$

There are two cases to consider:

- $R \leq A$: then there is no trade-off between output and inflation; inflation can be set at its desired level at no cost in terms of output ($\pi = 0$ and $y = Ak$);

- $R > A$: then there is a trade-off between output and inflation: the central bank either inflates ($\pi = R/A - 1$ and $y = Ak$) or implements the desired inflation target ($\pi = 0$ and $y = Ak - \gamma$). The former course of action is preferred if,

$$a\left(\frac{R}{A} - 1\right)^2 < \gamma. \qquad (13)$$

We necessarily have $R^* > A_L$ since $A_L < 1$. But a priori, R^* could be larger or smaller than A_H. First, let us look for equilibriums in which $R^* \leq A_H$. Then if the risk aversion parameter a is not too high (i.e., condition (13) is satisfied for $A = A_L$), the policy reaction function is given by (7). The lenders' zero profit condition (13) then reduces to

$$1 = (1-p)R^* + pA_L,$$

which yields a closed-form expression for the equilibrium gross interest rate,

$$R^* = 1 + \frac{p}{1-p}(1 - A_L). \qquad (14)$$

Using this expression and $A = A_L$ to substitute out R^* and A from (13) gives a condition on the exogenous parameters of the model,

$$a < \gamma \left(\frac{1-p}{1-A_L} \right)^2 . \quad (15)$$

Note that (14) implies $R^* < A_H$ since $E(A) > 1$. Thus, if (15) is satisfied, there is an equilibrium in which the policy reaction function is given by (7).

Can there be an equilibrium in which $R^* > A_H$? In such an equilibrium the creditors receive either Ak (if the central bank inflates) or $Ak - \gamma$ (if the central bank does not inflate). Such an equilibrium does not exist in pure strategies because the right-hand side of (12) does not depend on R. There could exist, however, equilibriums with mixed strategies, in which the central bank randomizes over π in the high-productivity state or the low-productivity state. In those equilibriums the level of R is such that the central bank is indifferent between inflating or not, i.e., condition (13) is an equality. Those mixed-strategy equilibriums are Pareto-dominated by the pure strategy equilibrium (7).

Next, let us consider the optimal policy rule, in which the central bank announces ex ante a policy function $\pi(R, A)$. Then one can see that a rule cannot yield a strictly higher level of welfare than in the pure strategy equilibrium (7). The only reason that a rule might dominate discretion is that the policymaker takes into account that R is affected ex ante by the rule. However, a rule cannot produce an equilibrium interest rate that is not the same as under discretion. The equilibrium interest rate under the optimal rule cannot be smaller than $A_L < 1$ nor larger than A_H (otherwise it would be dominated by discretion). But if $A_L < R < A_H$, it is easy to see that the optimal rule coincides with the discretionary solution, i.e., inflate if and only if productivity is low. Hence, the equilibrium R must be the same as under discretion. However, a rule could help eliminate the inefficient mixed-strategy equilibriums mentioned above.

References

Barro, Robert, and David Gordon, 1983, "A Positive Theory of Monetary Policy in a Natural Rate Model," *Journal of Political Economy* 91, pp. 589-610.

Bordo, Michael and Olivier Jeanne, 2002, "Monetary Policy and Asset Prices: Does Benign Neglect Make Sense?" *International Finance* 5, pp. 139-164.

Calvo, Guillermo and Carmen Reinhart, 2000, "Fear of Floating," *Quarterly Journal of Economics* 107, pp. 379-408.

Eichengreen, Barry, 1994, *International Monetary Arrangements for the 21st Century*, The Brookings Institution (Washington DC).

Fischer, Stanley, 2008, "Mundell-Fleming Lecture: Exchange Rate Systems, Surveillance and Advice," IMF *Staff Papers* 55, pp. 367-83.

Jeanne, Olivier, 2000, "Currency Crises: A Perspective on Recent Developments," *Special Papers in International Economics* 20, International Finance Section, Princeton University (Princeton NJ).

Jeanne, Olivier, 2008, "Inflation Targeting and Debt Crises," manuscript, Johns Hopkins University, in progress.

Kumhof, Michael, Li, Shujing, and Isabel Yan, 2007, "Balance of Payments Crises Under Inflation Targeting," IMF Working Paper 07/84 (Washington DC).

Mussa, Michael, Swoboda, Alexander, Zettelmeyer, Jeromin, and Olivier Jeanne, 2000, "Moderating Fluctuations in Capital Flows to Emerging Market Economies," in *Key Issues in Reform of the International Monetary and Financial System*, P. Kenen and A. Swoboda eds., IMF (Washington DC): pp.75-142.

Rogoff, Kenneth, 1985, "The Optimal Degree of Commitment to an Intermediate Monetary Target," *Quarterly Journal of Economics* 100, pp. 1169-1189.

Rose, Andrew K., 2007, "A Stable International Monetary System Emerges: Inflation Targeting is Bretton Woods Reversed," *Journal of International Money and Finance* 26, pp.663-681.

Svensson, Lars E. O., 2000,"Open-Economy Inflation Targeting," *Journal of International Economics* 50, pp.155-183.

Swoboda, Alexander, 1986, "Credibility and Viability in International Monetary Arrangements," *Finance and Development* 23, pp. 15-18.

Tirole, Jean, 2002, *Financial Crises, Liquidity and the International Monetary System*, Princeton University Press.

Townsend, Robert, 1979, "Optimal Contracts and Competitive Markets With Costly State Verification," *Journal of Economic Theory* 21, pp. 265-93.

Figure 1. Aggregate Supply

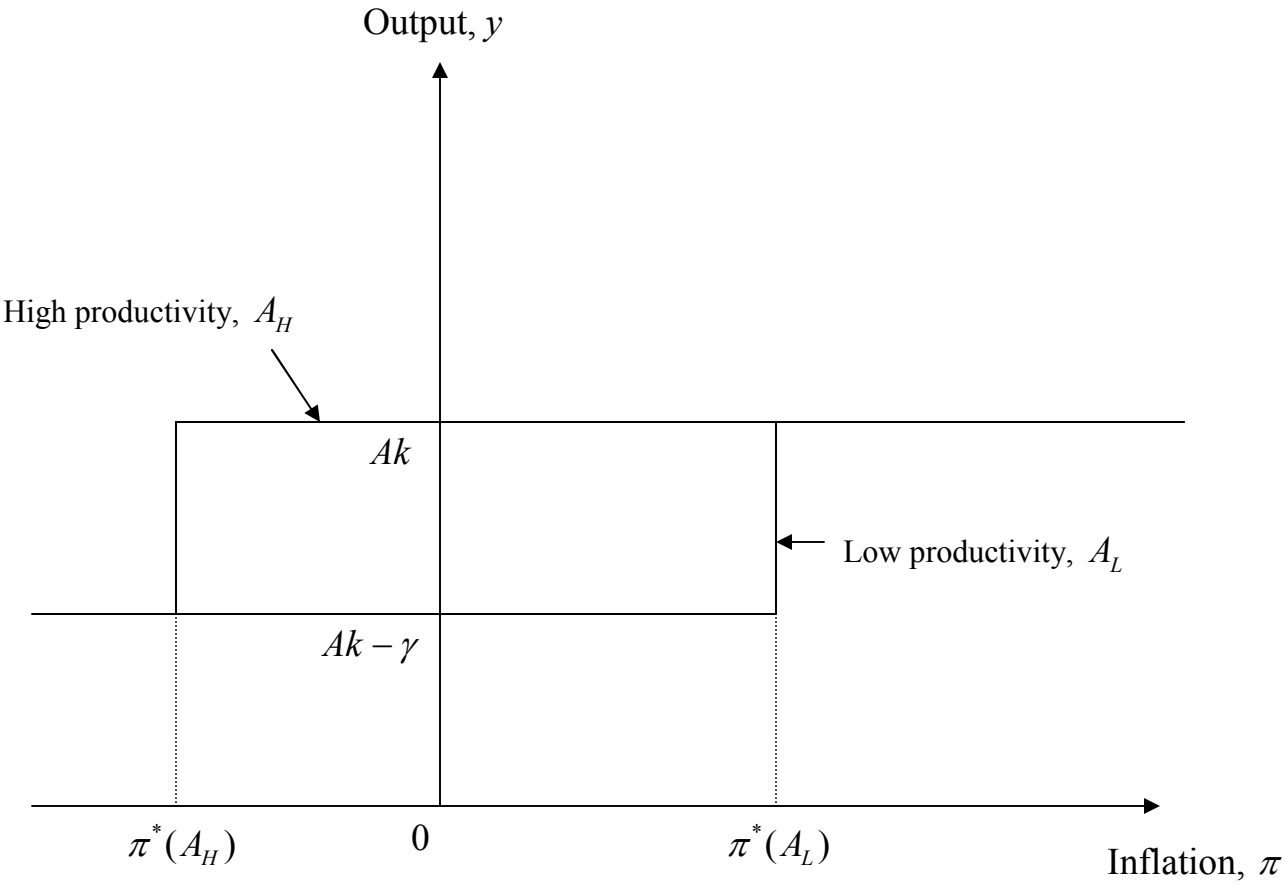

Figure 2. Welfare comparison of exchange rate regimes