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An Operational Definition of Price Stability

Tito Nícias Teixeira da Silva Filho

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(e-mail: workingpaper@bcb.gov.br)

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An Operational Definition of Price Stability¹

Tito Nícias Teixeira da Silva Filho²

Abstract

The attitude towards inflation has changed radically over the last decade. This changing was motivated, basically, by three factors: a) the high cost of inflation during the decades of 1970 and 1980; b) the less than expected global disinflation costs during the decade of 1990 and; c) the significant progress, in the last ten years, of the literature about the costs and benefits of inflation. Indeed, today one knows that inflation costs are well above than those estimated in the beginning of the decade of 1990. Part of this difference is due to the better identification and measurement of the perverse interaction between inflation and the tax system. By the other hand, some arguments in favour of “some” inflation have also gained terrain in the same period. And, despite the difficulties found when estimating some of specific inflation costs, there is currently a consensus that the overriding objective of monetary policy should be price stability. However, the advance of the literature was not yet capable of establishing what the optimal inflation rate is. This paper aims to show, in short, what are the main costs and benefits of inflation in the light of the last advances in the specialized literature. In this way, it aims to contribute to the discussion about what should be the long term inflation target for Brazil.

¹ The author wishes to thanks Francisco Figueiredo and Sérgio Lago.

² Research Department, Central Bank of Brazil, and Ph.D. student at the University of Oxford.
Author's e-mail: tito.dasilvafilho@wadham.oxford.ac.uk.

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1 - Introduction

The attitude towards inflation has changed radically over the last decade, especially concerning central banks behaviour. This change can be noticed under different perspectives. In the beginning of the 90's New Zealand began a new attitude by central banks regarding inflation, assuming explicitly that the overriding objective of the monetary authority is price stability. Since then, several central banks have decided to adopt the inflation targeting regime and this number keeps growing.

This change of behaviour was motivated, among other factors, by verifying that the rise of inflation in several countries during the decades of 1970 and 1980 did not bring any benefits in terms of higher output growth, on the contrary, the costs were high. Besides that, the global fall of inflation rates during the decade of 1990 showed that the costs of disinflation could be smaller than expected.³ And, notwithstanding the fact that during this period disinflation was benefited from benign supply shocks as, for example, the fall of the price of oil and several commodities as well, it became clearer with time that the new attitude of central banks towards inflation was the key ingredient behind the lower perceived cost of reducing inflation, i.e sacrifice ratio.⁴

In the academic environment, the rise of inflation rates during the decades of 1970 and 1980, in some countries sharply, provided the missing ingredient to establish empirically the link between inflation and growth. With the then available data, it was not possible to detect the adverse inflation effects on economic growth. In fact, during the decade of 90, benefiting from the previous two high inflation decades experiences, evidences of the existence of a long run negative relation between inflation and economic growth has begun to appear with frequency (Fischer, 1993; Barro, 1995; Sarel, 1996; Bruno and Easterly, 1998; Ghosh and Phillips, 1998).⁵

³ In some cases, as in the United States, the fall of inflation came together with the fall of unemployment rates and increase of economic growth rates.

⁴ According to several economists this phenomenon was caused by the increase of central banks' credibility. Blinder (1998), by the other hand, alerts that in spite of the appealing popularity of this argument, there are no evidences that it is true.

⁵ In the short run, it was already broadly accepted, especially by central banks, the existence of a trade-off between inflation and growth.

Empirical studies show, however, that this link is significant only in high inflation cases. Barro (1995), finds evidences that an increase of ten percentage points in inflation reduces economic growth between 0,2 e 0,3 percentage points per year. Note, however, that his results are fragile if one wants to make inferences at inflation rates below 15%. Using a non-parametric approach, Bruno e Easterly (1998) show that the transition probability to inflation rates higher than 100% increases rapidly when inflation is above 40%, value that is considered by the authors a break point.⁶ Sarel (1996) finds evidences that inflation rates above 8% harm economic growth.⁷ Ghosh e Phillips (1998) show that the adverse effects on growth occur from inflation rates as low as 3%.

Despite the lack of robustness found in some studies, one should stress that an increasing number of papers have been finding evidences that there is a negative relationship between inflation and long run economic growth.⁸ Moreover, the inflation breakpoint value – defined as the level of inflation beyond which the harmful effects on growth begin to appear – have been found to be smaller and smaller. Finally, as points out O'Reilly (1998), almost no study finds statistically positive coefficients for inflation.

The above picture has produced consensus among economists and central bankers that high inflation rates are harmful to growth and, therefore, are undesirable and should be avoided. More specifically, despite the dispersion found in the estimates regarding the inflation breakpoint value, there is a trend to consider high inflation rates as those above one digit (e.g. Fischer, 1996; Black *et alli*, 1998; Coletti e O'Reilly, 1998; Mishkin e Schmidt-Hebbel, 2000).⁹ Therefore, the empirical evidence regarding the relationship between inflation and economic growth is still inconclusive for inflation rates below 10%. Even though, there is a consensus that price stability should be the main objective of monetary policy. How one can conciliate these two facts?

⁶ According to the authors, this might happen due to the fact that there may be a tendency to index nominal variables explicitly when inflation reaches this level.

⁷ Sarel finds evidences of non-linearity in the Phillips curve, and shows that if one does not take this into account, the adverse inflation effects will be underestimated.

⁸ Some results depend crucially on the inclusion of very high inflation rates countries, or the results are very sensitive to the period under analysis.

⁹ One factor that helps to explain this dispersion is that those studies differ with regard to the used methodologies and their rigour. Moreover, as it will be seen, inflation costs depend, in a great extent, on the institutional features of each country.

Some factors help to elucidate this apparent paradox. First, the absence of an empirical relationship does not imply, necessarily, that it does not exist. The methodology used in those studies – regression equations for specific countries, cross-section e panel data – may have difficulties to find a relationship between those variables for low inflation.

This may occur due to several reasons, for instance: there are data limitations, since it still does not exist long periods of low inflation. This fact imposes important difficulties to this kind of study.¹⁰ There are difficulties to identify and control the effects of other variables than inflation, especially shocks, on the economy. These shocks may mask the benefits of low inflation. In this regard, the relationship between inflation and economic growth depends not only on the nature of the shocks that hits the economy but, mainly, on the central bank reaction function.¹¹ Moreover, inflation costs depend on institutional factors as, for example, the degree of indexation in the economy, especially of the tax system, and on labour legislation, which differs among economies.

Second, as argues Briault (1995), there are well established theoretical reasons that show why inflation, and uncertainty about inflation, reduce social welfare. Actually, inflation costs study is an old subject and the economic literature mention several specific motives through which inflation decreases social welfare. Note, however, that there are also arguments about the benefits of inflation.

Therefore, besides the literature that seeks to verify the existence of a relationship between inflation and economic growth, there is also a broad literature that aims to identify and measure several specific inflation costs and benefits. The latter, however, uses another methodology; one that is essentially microeconomic based, and therefore differs from the first, which uses time series techniques and regression analysis. In this context, several studies show that even low inflation rates have relevant social welfare effects.

¹⁰ This fact is even more relevant since, as argue Coletti e O'Reilly (1998), the theoretical arguments in favour of low inflation rates show that: a) the benefits of price stability take a long time to materialize. As it will be seen, inflation uncertainty can remain high by long spells after the fall of current inflation; b) the benefits of low inflation are relatively small each year, despite its permanent effects. By the other hand, disinflation costs are big and generally temporary.

¹¹ For example, if the central bank reacts to an increase in inflation by tightening monetary policy, it will be, at least in the short run, a negative relationship between inflation and growth.

Third, some specific inflation costs listed by this literature are difficult to measure empirically. Actually, what one wants to investigate is whether inflation affects society's welfare, and in what way this happens. In this regard it is essential to understand that GDP is an imperfect social welfare indicator, although both variables are clearly correlated. Some of the costs of inflation are not captured by GDP, even though they decrease social welfare. For instance, if price stability foster also greater economic stability it will increase social welfare, even if one assumes that inflation does not affect long term economic growth. In fact, Hess e Morris (1996) show evidences that there is a positive relationship in the long run between the level of inflation and output's variability.¹² Moreover, as alert Parkin (1997), some of the inflation costs are actually counted as benefits since they increase GDP, for example: the growth of the financial system.

Fourth, one cannot ignore the experience, even though still very recent, of those countries which have been aiming price stability as the foremost policy objective, and have been experiencing notable economic performance as, for example, the United States and England. It is worth noticing that in those countries price stability has not produced higher output volatility, but rather the opposite.¹³

The change of behaviour with regard to inflation and the fact that several industrialized countries have achieved inflation rates near or compatible with price stability has lead to a favourable environment in which the study of the costs and benefits of inflation has gained much interest. This fact is easily verified by the large growth of papers written about this subject, and by the realization of several seminars about price stability in the last years.

Behind this discussion lies not only the search for a better understanding of the costs and benefits of inflation but, mainly, by the attempt of determining the optimal inflation rate. That is, one seeks to determine how low inflation should be in the long run, or yet, what is the inflation target that maximises society's social welfare.

¹² According to Meltzer (1997), during the well succeed disinflation period in the last fifteen years, the United States experienced the most stable cyclic period ever. Meltzer argues that recessions are, generally, caused by "particular inflationary imbalances". Poole (1999) says that the recent experience of the United States suggests that low inflation not only decreases inflation's variability but also output's variability.

In this way, this paper has three main objectives. First, review briefly the literature about the benefits of price stability and, more specifically, some studies that identify or quantify the specific costs and benefits of inflation. As already observed, despite being an old issue, this literature experienced a strong growth in the last decade. Second, show preliminary evidences of some costs of inflation for Brazil. Third, based in the abovementioned review proposes a long term inflation target for Brazil.

Since the adoption of the inflation targeting regime in Brazil, in the middle of 1999, the inflation targets were: 8% in 1999, 6% in 2000, 4% in 2001, and 3,5% in 2002. Recently, the inflation target for 2003 was set at 3,25%.¹⁴ As the inflation target start to get closer to rates compatible to the concept of price stability, the debate about what should be the long term inflation target for Brazil will increase undoubtedly. This paper aims at providing subsidies that can be useful to this decision.

The paper is structured as follows: next section discusses the operational definition of price stability and the difficulties associated with it. Section 3 shows what the main inflation costs are, along with some preliminary evidences for Brazil. Section 4 shows what the inflation benefits are. Section 5 analyzes the current stage of the literature about the cost-benefit of price stability and shows some empirical evidences about the net benefits of low inflation. Based in the international experience and in the study of inflation costs and benefits, section 6 gives some clues about what should be the long-term inflation target for Brazil. Finally, section 7 concludes the paper.

2 – What Does Price Stability Mean?

Given the current consensus that price stability must be the overriding objective of monetary policy, it is important to know what economists understand by this concept. Literally speaking, price stability means that the economy's price level remains unchanged. Obviously, this does not prevent that changes in relative prices exist, however in the aggregate the price level does not change. In other words, the inflation rate equals zero

¹³ See last footnote.

Nonetheless, this is not the concept that is in economists' and central bankers minds when one talks about price stability. When one says that the main objective of monetary policy is price stability one really means that central banks must have as an objective low and stable inflation rates.¹⁵

One definition of price stability which has been much used is the one proposed by Greenspan (1996): "Price stability obtains when economic agents no longer take account of the prospective change in the general price level in their economic decision-making". The definition used by Blinder (1995) is similar: "The definition I've long used for price stability is a situation where ordinary people in their ordinary course of business are not thinking and worrying about inflation". Nonetheless these definitions are conceptually correct, they do not provide any clue about how low inflation should be.

Actually, even small inflation rates can have important effects in the long run, and cannot be ignored in the decision-making process. For example, consider that a 3% annual inflation rate meets the requirements proposed by Greenspan and Blinder. In 20 years, which is a period used in various economic contracts, the purchasing power of money will be reduced in, approximately, 80%. If the contract is longer, 30 years, a very common period in real estate deals, this value raises to around 140%.

Meltzer (1997) defines price stability as "an inflation rate so close to zero that it ceases to be a significant factor in long-term planning". Even though this definition is more precise than the previous ones, it also does not mention a specific value or interval.

Despite the intrinsic difficulties associated to the meaning of price stability, according to Fischer (1996), the central banks define it operationally as inflation rates between 1% and 3%. Some economists, however, consider 3% a high inflation rate for this purpose (Meltzer, 1997). Anyway, it is important to notice that no economist considers inflation rates higher than 3% compatible with price stability. By the other hand, some economists support inflation rates equal to zero. Therefore, one can say that the 0%-3%

¹⁴ Note that there is a two-percentage point interval around the central target.

¹⁵ Vickers (1999), for example, uses this concept.

interval encompasses all inflation rates that are considered coherent with the concept of price stability.

A crucial question at this point is: why price stability is not associated with a zero inflation rate, that is, with price level stability? Basically, there are two motives: economic ones, which will be dealt in the next sections, and the “statistical” ones, which makes explicit the difficulties associated with the correct measurement of inflation. In this sense, both factors must be taken into consideration when one talks about price stability.

For example, changes in the quality of goods, the creation of new goods and the substitution of goods in the consumption basket make measured inflation overestimate the “true” inflation. The example given by Greenspan (1996) is very useful in this regard:

“How, for example, should we decompose the enormous increase in nominal expenditure on medical care in recent years into its “price” and “quantity” components? Consider the case of cataract surgery. Forty years ago, the typical cataract patient had to endure a hospital stay of seven days, and required extensive post-operative vision correction because the eye’s natural lenses had been removed. Today, the typical patient is treated on an outpatient basis. Furthermore, in many cases the patient does not require any vision correction after the operation because artificial lenses have been employed. In light of these enormous quality improvements, we obviously cannot treat the unadjusted fee for a single operation as “the price of cataract surgery”. Instead, we must attempt to quantify the value of these improvements, and adjust our price indexes accordingly.”

Indeed, empirical studies show that measured inflation rates overestimate the “true” inflation, and that the bias can be significant. Recent studies show that in the United States inflation is overestimated in, approximately, 0,65% (Gordon, 2000), and between 0,5% e 0,7% in Canada (Crawford *et alli*, 1998). In this case, the operational definition of price stability will not be equal to zero inflation, but rather to a positive inflation rate numerically equal to the size of the bias.

However not everyone agrees that the bias should be taken into consideration when one defines operationally price stability. Summers (1996) argues that the bias is not relevant

when establishing an inflation target. In his words: “When I think about my future, I think about what it will cost in the future to buy a house or a tennis racket or a college education for my kids, and it's the sticker price, not the quality-adjusted change in cost, that I care about.” Fischer (1996) adds: "The impact of this bias on the optimal inflation rate of inflation is not self-evident if money illusion matters for real resource allocation"

Actually, despite the consensus that measured inflation is overestimated, there is a gap in the literature about the relevance of this bias in the definition of price stability, and how it affects monetary policy. Generally, economists do not deal in depth with this question. There are no studies about until what extent the bias is relevant to consumers' decision-making and to implementing monetary policy. Indeed, the debate about the costs and benefits of price stability, focus mainly in the economic motives. As one can see the operational definition of price stability is not a trivial task, even for good economists.

As it will become clear along the paper, price stability should be understood as a concept that is much broader than just the simple requirement of a low and stable inflation rate, whatever this rate is, but rather and above all as an state characterized by low and stable inflation expectations, that is, low inflation uncertainty.

Another question that is closely related to this discussion is the concept of optimal rate of inflation, that is, the inflation rate that maximises the society's welfare. Besides the statistical factors, now the economic factors play an essential role. Although both issues are related to each other, they raise distinct questions. One can say that price stability is a concept, while the optimal rate of inflation is its operational definition.

Graph 1 shows, for some industrialized countries, the phenomenon of the global fall of inflation rates during the decade of 1990 and the change of behaviour regarding inflation, that is, the quest for price stability. One can see that these countries have recently achieved inflation rates compatible with the concept of price stability. None of the nine listed countries had average inflation rate above 3% in the last five years, as shown in Table 1.

Graph 1
Annual Inflation Rates (CPI) of Several Industrialized Countries

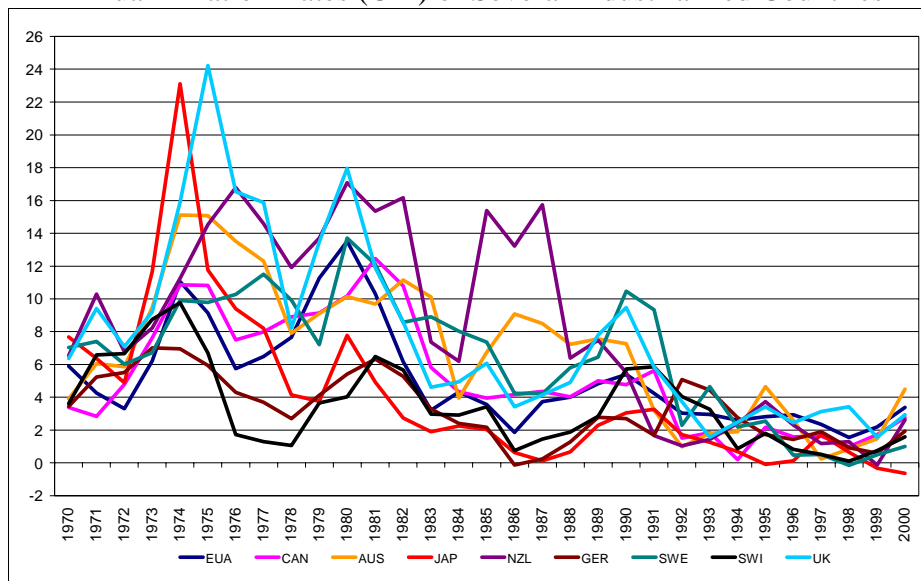


Table 1
Inflation (CPI) of Some Industrialized Countries: Five Years Averages

Country	1971-75	1976-80	1981-85	1986-90	1991-95	1996-00
United States	6.75%	8.89%	5.48%	3.96%	3.12%	2.48%
Canada	7.33%	8.74%	7.42%	4.46%	2.25%	1.73%
Australia	10.24%	10.57%	8.30%	7.92%	2.50%	1.92%
Japan	11.38%	6.63%	2.76%	1.35%	1.37%	0.30%
New Zealand	10.19%	14.80%	12.01%	9.59%	2.05%	1.45%
Germany	6.13%	4.04%	3.88%	1.36%	3.13%	1.35%
Sweden	7.95%	10.50%	8.99%	6.21%	4.17%	0.47%
Swiss	7.68%	2.34%	4.28%	2.51%	3.15%	0.75%
United Kingdom	13.00%	14.36%	7.19%	5.93%	3.40%	2.70%

Source: International Financial Statistics - IMF

3 – Inflation Costs

Inflation impinges upon society two kinds of costs: economic costs and social costs. These costs are originated both by expected and non expected inflation.¹⁶ It is important to notice, therefore, that inflation costs do not stem only from its level but, mainly, from the uncertainty regarding its future values even though, as it will be seen, both facts are correlated.

¹⁶ Colleti and O'Reilly (1998) make the following differentiation: "Fully expected inflation is inflation that is correctly predicted by all individuals in the economy. Fully anticipated inflation is inflation that is

Inflation provokes loss of social welfare basically for two reasons: a) it makes economic agents change their behaviour. These (defensive) changes imply efficiency loss as efforts are diverted from more productive activities to less productive activities, whose only goal is to protect economic agents' income and wealth against inflation effects; b) inflation decreases the quality of the information provided by the price system and increases uncertainty regarding the future, distorting efficient resource allocation. As a consequence, not always the decisions made in the present will be revealed to be the best ones in the future, even though given the information available at the time they were taken, they seemed to be the correct ones.

3.1 – Costs of Expected Inflation

One of the first inflation costs identified in the literature stems from the fact that inflation acts as a tax on money balances that individuals hold. Since money does not earn interest its purchase power decreases when there is inflation. The higher inflation is the higher the inflation tax will be and the higher the decreasing of purchasing power. Since money is an essential good, in the presence of inflation economic agents change their behaviour trying to minimize their losses instead of just quitting using money. This change of behaviour causes economic inefficiency as people spend time and resources trying to protect themselves against inflation.

For example, as inflation rises people go more often to banks in order to withdraw money, since they desire to keep less currency in their pockets. In this way, the time consumed trying to minimize the effects of the inflationary tax produces loss of social welfare. This kind of cost is known in the literature as shoe leather costs, and it is represented by the appropriate area under the demand curve for money.¹⁷ In order to finish with this inefficiency, given that the marginal cost of producing money is practically equal to zero, Friedman proposed that the nominal interest rate should be zero. This means that inflation must be negative and equal to the real interest rate. Note however that with the advances of technology and the creation of new financial instruments and ways of payment, this cost has decreased considerably nowadays.

fully expected and adapted to by all individuals in the economy". In this paper both expressions are considered equivalent.

¹⁷ It depends, among other things, on the functional form of the demand for money function and on its interest rate sensitiveness.

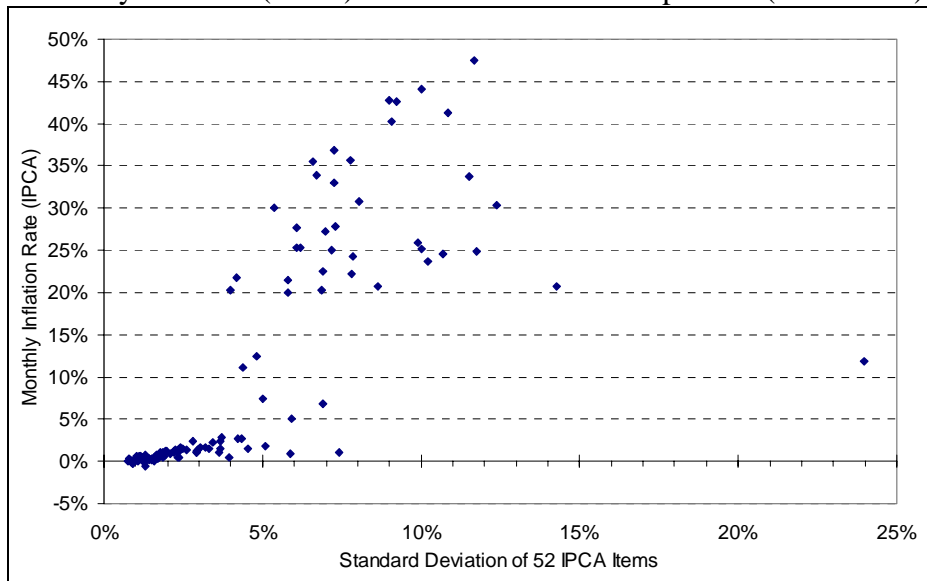
Inflation also provokes more general changes in behaviour, which are not related to the demand for money. As inflation rises, the variability of relative prices also increases, and the quality of the information provided by the price system decreases.¹⁸ In this case, it is not easy to differentiate whether price increases are due to changes in relative prices or simply caused by decreases in the purchasing power of money. In this way, decisions taken based on relative prices in a given moment may prove themselves wrong later. The costs involved can be high mainly if the decisions affect long-term investments.

Note also that besides increasing the dispersion of relative prices inflation also increases the dispersion among prices of the same good. That is, decisions about buying or selling are taken in an environment of greater uncertainty. Therefore, it is more difficult to make the correct decisions. Second, according to Coletti and O'Reilly (1998), the increase in uncertainty can cause overinvestment (or underinvestment) in some goods, implying high adjustment costs in the future.

Graph 2 shows, for Brazil, that there is a strong positive relation between the inflation level, measured by the Broad Consumer Price Index (IPCA), and the dispersion of relative prices, measured by the standard deviation among the 52 groups that forms the IPCA. Another interesting result is that it seems to be a qualitative change in this relation when monthly inflation rates are above 4%; above this value, there is an increase in the relative variability of inflation.

But why inflation increases price dispersion? Part of the answer makes another inflation cost explicit. Price changes involve costs that include, among others, the substitution of price tags and the making of new price lists. This cost is known in the literature as menu costs. As a consequence, the entrepreneur will only change his product's prices from the moment that the gains of doing so is greater than the cost involved. This means that price changes are usually realized in discrete intervals. As inflation rises price changes also increase, augmenting price dispersion. Note, however, that due to the improvement in technology, especially in computers and software, the cost of changing prices has decreased considerably.

Graph 2
Monthly Inflation (IPCA) and Relative Prices Dispersion (1991-2001)



Inflation also increases price dispersion due to other reasons. Each firm has a different cost structure and specific policies concerning price changes, these factors means that price changes are not synchronized.¹⁹

In the same manner that inflation distorts information provided by the price system of good and services markets, it also distorts the functioning of the labour market. Inflation increases wage dispersion among different categories of workers and within the same group of workers as well, causing misallocation of resources in the labour market. In other words, inflation acts as sand in the wheels of the labour market.

It is not difficult to conclude that the higher inflation is the higher the need of people and firms to spend time and resources searching prices, so as to their decisions are less affected by the distortions caused by inflation. In the same way it is not difficult to notice that this situation causes economic inefficiency and decreases social welfare.²⁰

At the time inflation was high in Brazil, these costs were evident and high. For example, during that period it was easy to observe a huge growth in the size of firms' accounting

¹⁸ As already observed, even with zero inflation relative prices of goods and services vary.

¹⁹ For example, some firms may continue to sell their products by the “old” price, until the inventories built with cheaper prices finish. For other firms, as soon as new and more expensive products arrive the whole inventory prices go up.

²⁰ As points out Briault (1995), even though by the individual viewpoint it is worthwhile to spend time and resources forecasting inflation, by the social viewpoint this behaviour produces inefficiency.

departments. Regardless whether there is legal monetary correction of balances or not, with high inflation traditional accounting does not reflect precisely the true patrimonial situation of firms anymore. In this regard, there is the need to calculate the real value of items and to take into account the effects of inflation on firms' profits. As a consequence, productive resources are diverted into this type of activity.

Another consequence of inflation is the growth of the size of the financial system in relation to GDP.²¹ Note that this growth is not due to the increase in the level of activity but rather due to the attempts of minimizing the undesirable effects of inflation. The higher need that economic agents have to protect themselves against inflation, foster the creation by banks of several financial instruments. Once again, productive resources are diverted from more productive activities in order to minimize the costs of inflation.

Among the numerous costs of inflation, empirical studies emphasize the one originated by the perverse interaction between inflation and the tax system.²² In general, the tax system and economic contracts are not perfectly indexed to inflation. As a consequence, inflation causes an increase in the effective tax rate. The higher the inflation rate the higher the increase in the effective tax rate.²³

The interaction between inflation and the tax system provokes several undesirable consequences as, for example, the decrease of disposable income and, therefore, the aggregate consumption level. This happens every time the income tax table is not corrected by the inflation, and economic agents are taxed over their nominal income and not over their real income. Besides that inflation distorts savings and investment decisions, since the real return of investment and financial applications are adversely affected by inflation. This happens mainly because capital and interest rate gains due exclusively to inflation are treated as taxable income.

With regard to interest payments, notice that inflation widens the difference between the interest rate paid by the debtor and the interest rate effectively received by the creditor

²¹ Another indicator, which shows this phenomenon, is the increase of the number of people working in the financial system.

²² According to empirical studies, among several estimable costs of inflation, this is the most significant.

²³ Notice that, if at each period nominal values over which tax is levied are not corrected by inflation, even if the inflation rate is stable the effective tax will raise period after period.

(Dewald, 1998). This occurs since, in general, creditors are taxed over nominal interest gains. Besides that, debtors are generally allowed to deduct nominal interest payments. In this way the tax burden impinged on creditors are higher than the one impinged upon debtors (Smal, 1998).

Furthermore, notice that inflation distorts investment decisions by decreasing the real value of depreciation, since accountancy rules in general does not take into consideration all inflation effects on investment values. This fact affects adversely the profitability of investment and produces significant allocation effects.

3.2 – Costs Due to Inflation Uncertainty

The aforementioned costs occur even if inflation is perfectly anticipated. Actually, in real world inflation is not perfectly anticipated since its future values are always uncertain, i.e. there is inflation uncertainty.²⁴ Empirical evidences show that the higher the inflation rate is the higher the inflation uncertainty is.²⁵

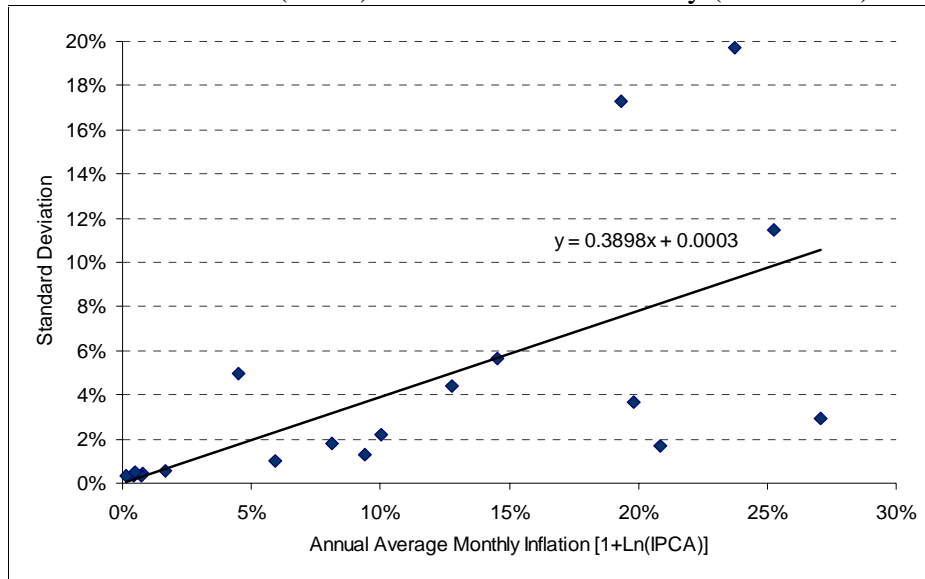
According to Vickers (1999) that happens, among other factors, due to the fact that when inflation is high inflation expectations are not anchored and begin to drift. Coletti and O'Reilly (1998) argue that countries have high inflation rates because they try to achieve unfeasible objectives through unsustainable policies, which creates an outlook of uncertainty. In this way, the smaller current inflation is the smaller uncertainty regarding its future values is. Golob (1994) mention the uncertainty produced by the timing and by the effects of short run policies aiming at reducing inflation. Ball (1992) draws attention to the uncertainty stemmed from policymakers' preferences, given the existence of a trade-off between inflation and unemployment in the short run.

Graph 3 shows, for Brazil, preliminary evidences that there exist a positive relationship between the level of inflation and the degree of inflation uncertainty. The standard deviation of (the logarithmic of) monthly inflation, for each year, was used as a *proxy* for inflation uncertainty.

²⁴ Note that, even if inflation is anticipated, it also produces uncertainty by increasing the variability of relative prices and by distorting information provided by the price system.

²⁵ In this regard see Golob (1994).

Graph 3
Inflation Level (IPCA) and Inflation Uncertainty (1982-2000)



A brief digression is necessary at this point concerning the techniques used in the literature to measure inflation uncertainty and its limitations. Different empirical studies have used different proxies in order to measure inflation uncertainty.²⁶ The first studies used the inflation variability with this purpose. Later on, due to the limitation of this procedure two new techniques arose. The first one measures inflation uncertainty through market surveys about inflation expectations. Recently, the use of econometric inflation forecast models have been the most used technique.

The use of inflation variability with the aim of measuring inflation uncertainty has some limitations since many times it is possible to forecast changes in inflation and, therefore, the use of the standard deviation can overestimate the “true” uncertainty. By the other hand opinion surveys may be misleading, since some of the participants are not in charge of relevant decisions. It might be important differences between expectations, and the degree of risk aversion, of those who make the forecasts and those who actually bet or invest. Finally, not all economic agents have access to econometric inflation forecast models. Moreover, differences among forecasts produced by different models may be substantial.²⁷ This fact suggests that inflation expectations may be very heterogeneous.

²⁶ A survey of the techniques used in several studies can be found in O’Reilly (1998).

²⁷ For example, univariate forecast models of inflation do not consider other information when forecasting

Additionally, several factors that produce uncertainty as, for example, the political and institutional environment, are not taken into account by those models. Generally, these factors are the main source of uncertainties. One must bear in mind that this procedure is subject to the same kind of criticism of opinion surveys, since economists who estimate models and write papers about inflation uncertainty do not make decisions.

However, despite the limitations of this procedure, this paper use the standard deviation of inflation with the aim of measuring inflation uncertainty, basically due to two motives: a) it is easy to calculate; b) opinion surveys about inflation expectations have only begun to be carried out very recently in Brazil. In this sense, the results show in Graph 3 should be taken as preliminary. Anyway, one expects that, in some degree, inflation variability and inflation uncertainty be correlated.

The main costs of inflation uncertainty stem from the fact that it also produces uncertainty about future interest rates. By the Fisher equation (equation 1), the nominal interest rate is equal to the expected rate of inflation plus the real interest rate. When inflation is perfectly anticipated, changes in nominal interest rates reflect basically changes in inflation expectations. However, when there is inflation uncertainty, economic agents demand a risk premium that will be included in the required real interest rate (equation 2). This happens because there is no certainty regarding the real interest rate in the future.

$$R = \pi^e + r \quad (1)$$

$$r = \bar{c} + \gamma \quad (2)$$

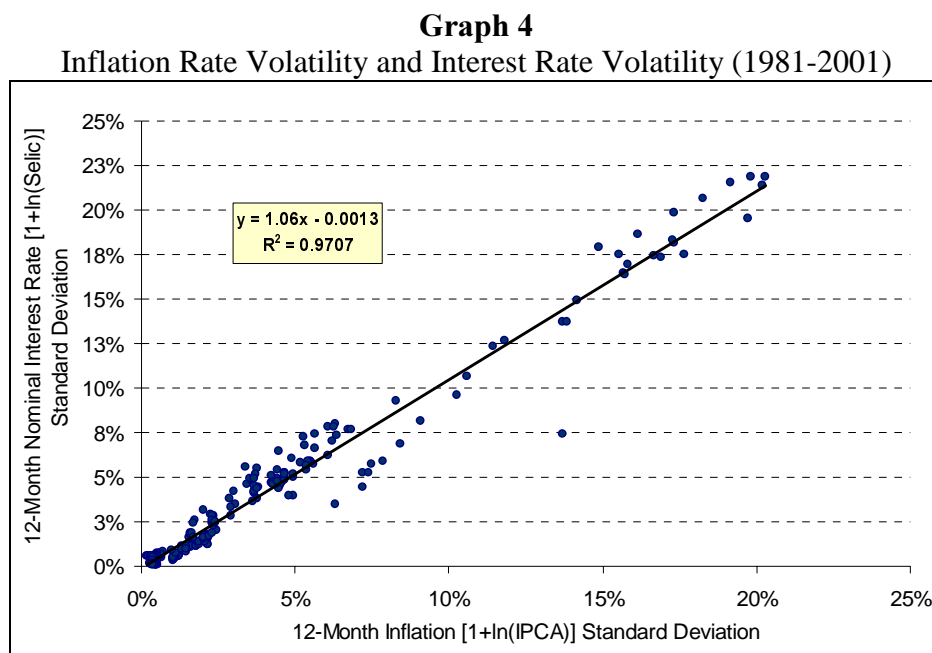
where: π^e = expected inflation rate; r = real interest rate; \bar{c} = riskless real interest rate and γ = inflation uncertainty risk premium.

In this way, the higher the inflation rate the higher the degree of inflation uncertainty and the higher the risk premium embedded in the required real interest rate and, therefore, the higher the nominal interest rate. Notice, moreover, that the existence of

future inflation values.

inflation uncertainty makes it harder to measure the “true” real interest rate required by economic agents.

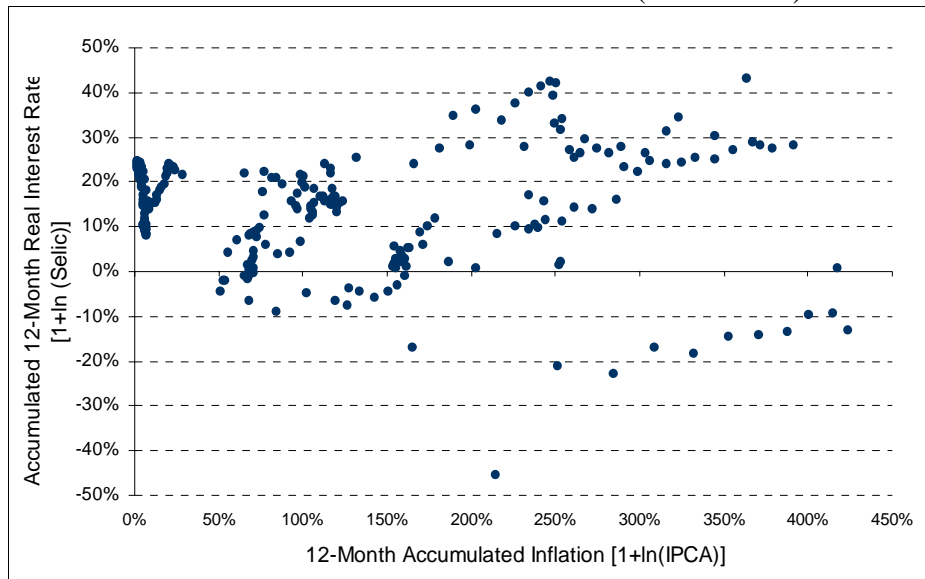
Graph 4 shows, as expected, that there is a strong positive relation between the volatility of inflation and the volatility of interest rate. This fact shows that the higher the inflation the higher the uncertainty about future interest rates.²⁸ As a consequence, high inflation rates are associated with high real interest rates, as Graph 5 shows. Note that the negative real interest rates that appears on the graph are mainly the consequence of several stabilization plans and others interventions in the economy.



After verifying that inflation uncertainty also means interest rate uncertainty, which is one of the key prices of the economy, one can identify more accurately and understand more clearly its costs. The most intuitive cost of inflation uncertainty is the allocation cost. Actually, inflation uncertainty interferes in several manners in the efficient resource allocation. Empirical evidence suggests that the costs originated from inflation uncertainty are higher than those that are originated from relative prices dispersion (Coletti e O’Reilly, 1998).

²⁸ Despite the abovementioned limitations, the implicit assumption is that a variable’s variability indicates the uncertainty regarding its future values.

Graph 5
Inflation Level and Real Interest Rate (1981-2001)



Decisions from consumers, banks and government about buying, selling, saving and investing depend not only on current prices and interest rates but also mainly on their future values. Therefore, besides the uncertainty about future prices of goods and services the uncertainty about the future real interest rate, which is a key variable for investment and saving decisions, interferes in the efficient resource allocation and economic agents planning. Note that the allocation costs are independent from the fact whether the forecast are proved to be right, since uncertainty interferes at the time decisions are taken.

By raising the real interest rates paid by the government, inflation uncertainty increases the cost of public debt. Therefore, the higher the price stability the lesser the inflation uncertainty will be and the higher the government's saving with interest payments. This extra saving means higher resources to be spent in other areas (e.g. health, education) or the possibility of decreasing tax rates.

Notice that the increase of the real interest rate does not disappear completely with the issuing of inflation indexed public bonds, since generally only a fraction of the public debt is post-indexed.²⁹ Moreover, the increase of inflation can raise other types of uncertainties, such as those originated by political risk or even default risk. All these

²⁹ The existence of pre-fixed public bonds decreases the efficiency of monetary policy. This inconvenience, among others, prevent that the entire public debt is indexed to inflation.

kinds of risk are embedded in the real interest rate and, therefore, the issuing of inflation indexed bonds minimises, but not solves the problem.

In a broader way, inflation uncertainty raises all kinds of interest rates within the economy, and not only those paid by the government. Although in an asymmetrical way inflation uncertainty raises short, medium and long run interest rates.³⁰ The rise of interest rates discourage investment overall in the economy. In other words: the fall of interest rates due to lesser uncertainty provokes a rise in the amount of disposable resources available to investment by the private sector (crowding in).

Another intuitive effect of inflation uncertainty is to shorten economic agents' planning periods. Inflation uncertainty discourages economic agents to adopt long-term contracts, whether because its cost is prohibitively high or because they do not exist. These contracts are important since they provide greater protection and predictability (especially prefixed contracts).

In some cases, inflation uncertainty may lead to the disappearance of some markets. According to Coletti e O'Reilly (1998) this was what happened with the 25-year-fixed-rate mortgages in Canada, which with price stability have resumed recently. In Brazil, the examples are even more incisive since some types of markets have never existed as, for example, the long-term prefixed public bonds market and the long-term prefixed financing real estate market. Even in the case of the more common post-fixed real state financing market, the interaction of high and uncertain inflation together with the incomplete indexation of instalments have contributed to a large decrease in the amount of real state financing in Brazil.³¹

Notice that despite the fall of inflation in the last years, the continuing existence of an environment of high inflationary uncertainty has been preventing the adoption of longer economic contracts and, more precisely, a better development of the housing market in Brazil. Despite the existence of housing medium term (ten-years) prefixed financing,

³⁰ Long term interest rates are the ones that suffer the most the effects of inflation uncertainty.

³¹ Another adverse consequence was the increase of the so-called quasi-fiscal deficit, which reached a large amount and today is still a burden for the future generations. Even considering that the "financial engineering" of these contracts has, in some extent, a political component, price stability does not avoid this type of disequilibrium to arise.

the interest rates charged are so high that prevent several people to use it. In the same way inflation uncertainty have been preventing the issuing of prefixed medium and long term public bonds. It is not difficult to conclude that those markets that deal with longer periods are the ones that suffer the most the effects of inflation uncertainty.

This kind of market is necessary to make viable projects that are profitable only in the long run. That is, the inexistence of long term contracts foster mainly short-run investments to the detriment of long-run investments, which may be a more efficient way of investment (Briault, 1995).

In the same way, inflation uncertainty fosters some specific kinds of investments, at the expense of others more productive. This is the case, for example, of the investment on real assets, especially real state, which works as protection against inflation. In addition to the loss of economic efficiency, this fact may produce serious disequilibria with high adjustment costs in the future.

The Brazilian experience is peculiar in this regard, since during the high inflation period, due to inflation uncertainty and to imperfect indexation of tenancy agreements, a significant fraction of house owners preferred to keep their houses empty than to rent them. Therefore, a peculiar situation was created, in which real estate was considered a good investment (hedge against inflation) and, at the same time, due to inflation, very often they did not produce any income, since landlords refuse to rent their property.

Inflation uncertainty also encourages the creation of financial instruments that offer protection against inflation surprises in the future and its effects on other economic variables.³² This protection, however, have a cost which many times can be high. That is, in the same way as in the last case, productive resources are diverted to economic activities that the sole purpose is to protect against inflation uncertainty costs.³³ Besides that, as note Coletti e O'Reilly (1998), many times protection strategies used are so complex that may, ironically, increase and not decrease, the associated risks. However,

³² As already seen, even if inflation is perfectly anticipated, there is an incentive to the creation of new financial instruments and, therefore, to the increase of the size of the financial system as a proportion of GDP. In this case, one should differentiate between those financial instruments that aim to protect against the loss of purchasing power and those which aim to minimise the effects of inflation uncertainty.

³³ Notice that, even if it is worthwhile from an individual point of view, from an economic point of view

even when this is not the case, these instruments are not always viable or are accessible to all economic agents.

In the time inflation was high in Brazil, inflation uncertainty demanded that several private banks built their own team of price survey with the aim of forecast future inflation. This example illustrates well the how productive resources were diverted.

In addition to the uncertainty regarding future interest rates, inflation uncertainty also affects, directly or indirectly, expectations regarding other economic variables values. For example, the two main theories of exchange rate determination show that the exchange rate is influenced by both the interest rate and the inflation rate. In this manner, inflation uncertainty implies additional uncertainty concerning future nominal and real exchange rates.

Inflation uncertainty also means uncertainty regarding future real wages, prefixed financing payments and some kinds of income.³⁴ For example, in this situation the real interest payments of prefixed bonds are uncertain as the real value of any prefixed financing instalments. This uncertainty harms economic agents planning and decrease economic efficiency.

Similarly, due to the imperfect indexation of the tax system inflation uncertainty means that future effective tax rates are uncertain and, therefore, the real return of investments and financial applications are also uncertain. As seen, this fact distorts consumption and saving decisions and harm capital accumulation.

Finally, frustrated expectations regarding future inflation (and, therefore, interest rate) can produce unexpected wealth transfer from creditors to debtors and vice-versa. This will happen whenever contracts are denominated in nominal terms and occurred inflation is different from expected inflation. Despite difficult to measure, these redistributive costs can be highly significant causing default of firms and banks and even producing financial crisis. This was the main cause of the crisis in the savings and

there is loss of efficiency and social welfare.

³⁴ As real future wages are less than expected the probability of strikes increases. This events decrease social welfare in so far as not only they harm the workers involved but, many times, some important parts of the population.

loan industry in the United States in the end of the 70's (Golob, 1994).

3.3 – Inflation Expectations, Uncertainty and Credibility

Despite existing evidences show that inflation uncertainty increases as inflation rises, future inflation can be uncertain even in an environment of low inflation. The main reason for that is very simple: low inflation in the present does not guarantee low inflation in the future. Therefore, inflation uncertainty has also a time component. This phenomenon is common whenever policymakers have low credibility.

In these cases, inflation expectations are asymmetric, since the probability that inflation rises is considered to be higher than the probability that inflation remains Constant or decrease. This happens, basically, because disinflation implies social costs. As says Meltzer (1997), a great part of the inflation risk stems from the fact that, once inflation is out of control the process of bringing it back is long and painful.

If the central bank has low credibility and the economy is hit by a shock that raises inflation, given the existence of a trade-off between inflation and unemployment in the short run, economic agents will not be sure about what strategy the central bank will follow: give priority to economy growth and let inflation rises or seek price stability and tight monetary policy.³⁵ Therefore, even with low current inflation rates it is possible that real interest rate includes a significant inflation uncertainty premium.

Moreover, notice that credibility is a valuable and very difficult to obtain asset, since once damaged, it takes a long time to regain it. Therefore, long-term interest rates can remain high due to inflation uncertainty despite the current level of inflation.

The lack of credibility matters basically due to two reasons. First, its existence prevents the achievement of a real price stability environment, since future inflation remains to be a reason to worry about, distorting economic agents' decisions. Second, it is believed that credibility decreases the cost of disinflation, since inflation expectations are an

³⁵ This analysis does not get into the issue about the nature of the shock, that is, whether it is a supply or demand shock, or whether it is temporary or permanent, since central bank's reaction depends on this information.

important component of inflation's dynamic.³⁶

Credibility is even more important when one considers that the central bank does not control precisely inflation in the short-run, since the economy is subject to several kinds of shocks. In this regard, one should stress that the way the central bank reacts to shocks depends on its nature and its length. However, many times it is very difficult to have a clear assessment about the shocks that hit the economy. If the central banks have credibility these shocks will not modify people's expectations about future inflation, fostering a more stable environment. Credibility depends, among other factors, on the way central bank acts and the degree of transparency involved in those actions.

4 – Benefits of Inflation

Before analysing the economic arguments in favour of inflation it is worth noticing that: a) the allegedly, and controversial, inflation benefits refer to low inflation rates only, since it is broadly accepted that high inflation rates are detrimental to economic growth. More specifically, one can say that the controversy centres itself to the question of which inflation rate in the 0%-3% interval the central bank should adopt as a long term target; b) according to most economists, the simple existence of a positive bias in measured inflation implies that the desirable inflation rate must be positive.

That is, besides the “statistical motive”, economists also stress the role of economic motives in favour of “a little” inflation. The main argument is that inflation greases the wheels of the labour market (Tobin, 1972; Akerlof *et alli*, 1996; Fortin, 2001). The reasoning is as follows: inflation improves the working of the labour market, since nominal wages are rigid downward. Therefore, “a little” inflation facilitates the adjustment of real wages when economic conditions change or when the economy is affected by shocks.

³⁶ As already pointed out, despite its attractiveness of this argument among economists, according to Blinder (1998), there are no evidences that it is true.

As a consequence, inflation not only would milder the effects of economic fluctuations over income and employment level, but could even decrease permanently the natural rate of unemployment. That is, there would be a long-run trade-off between inflation and unemployment at low inflation rates. It means that the Phillips curve would not be vertical at low rates of inflation.

An implication of this claim is that very low inflation rates would tend to produce higher output variability. However, as argues O'Reilly (1998), if by one hand a non-vertical Phillips curve increases the costs of disinflation at low inflation rates, by the other hand it also increases the benefits of price stability, since inflation is less sensitive to the output gap and, therefore, it is more stable and easy to control at low inflation rates.

Notice that, even considering that nominal price decreases of goods and services are a more common phenomenon than nominal wages decreases, the above argument also applies to the goods and services markets. All that is required is that there is some degree of price rigidity in those markets.

Actually, there is yet some controversy about the degree (and the existence) of price rigidity, especially in the labour market. For example, Akerlof *et alli* (1996) argue that some surveys built to measure nominal wage stickiness were not well done and, therefore, their conclusions are misleading. Despite the inherent difficulties associated with this kind of empirical investigation, some economists find this phenomenon sufficiently self-evident. Fischer (1996) argues: "any academic economist old enough to have been chairperson of the department knows that giving a small nominal increase is disproportionately easier than no change or a wage cut".

Other economists argue that nominal wage stickiness is the result of a high inflation culture and not a structural characteristic of the economy (Vickers, 1999). In this way, nominal rigidity would tend to disappear in a different inflation regime (Poole, 1999). Therefore, the costs due to wage rigidity are not a valid argument against very low inflation targets, or even zero target inflation.

Furthermore, there are other ways of adjusting nominal wages downward besides decreasing nominal wages (Poole, 1999). Real wages tends to increase over time due to productivity gains. Additionally, many times earnings are composed by two components: a fixed part, the wage, and a variable part, which depends not only on the employee's performance but also on the firm's performance. This kind of contract has been more and more common nowadays. In this sense, when a firm needs to decrease its employee's real wages, it only has to postpone wage increases due to productivity gains or decrease the variable part. That is, the existence of downward nominal wage rigidity might not be as important as one thinks.

Indeed, the recent experience of several countries that have been pursuing price stability as their overriding policy objective, specially the United States and England, puts in danger this kind of argument. These countries have been able to simultaneously reduce their rates of unemployment and inflation. Despite the differences in the functioning and in the structure of the economy among several countries, this fact shows that low inflation does not mean, necessarily, increase in unemployment rates.

Finally, if by one side some inflation may facilitate the adjustment of relative prices (grease in the wheels), by the other side it distorts the information provided by the price system by augmenting price variability (sand in the wheels) (Groschen e Schweitzer, 1997a). That is, according to this argument, ironically, some inflation may worsen the problem that, in theory, it was supposed to solve.

Another very often cited reason in favour of some inflation stems from the impossibility of nominal interest rate to be less than zero. In reality, this is an old subject that resumed in importance in the last years, as several countries have been achieving inflation rates near to zero. By the Fisher equation the lesser the inflation rate the lesser the nominal interest rate. However, in certain occasions, more precisely when the level of activity is weak, the policymaker sometimes needs to adopt very low real interest rates and, in certain occasions, even negative ones. Therefore, very low inflation rates may constraint the capacity of central banks to do anti-cyclic monetary policy.

A very often cited example in this regard is the situation experienced by Japan in the last years. With nominal interest rate virtually equal to zero, the Japanese central bank

was not able to decrease it further in order to stimulate the economy. A more profound analysis, however, reveals that a non-trivial conjunction of factors, jointly with past policy errors, have produced this situation. In general, similar situations are very hard to be found.³⁷ That is, one can argue that the Japanese case is an exception rather than a rule, in a situation with very low inflation rates.

Anyway, it is hard not to recognize that very low inflation rates may impose a narrow space to further decreases in the nominal and, therefore, real interest rates. However, as notice some economists, monetary policy works through several channels and the interest rate is only one of them, even though it is the most important (Meltzer, 1995). Poole (1999) argues that what matters for monetary policy is the growth of money stock and not the interest rate. Therefore, he says that the allegedly trap created by a rate of interest equals to zero does not make sense, since the central bank is always able to increase the liquidity of the economy. That is, even though very low inflation rates restrict the degrees of freedom of monetary policy, they do not make the monetary policy ineffective.

Another argument in favour of some inflation is that in economies with inflation near zero, the probability of the occurrence of deflation increases (Mishkin e Schmidt-Hebbel, 2000). In general, economists fear more deflation, especially due to its adverse effects on consumption, than moderate inflation rates. Nonetheless, with the advances of economic theory and the improvements in the “art” of central banking, this situation is likely to be avoided through good quality monetary policy. Furthermore, this risk seems to be higher only concerning zero inflation targets.

Lastly, there is the argument that inflation provides extra revenue to the government. According to Fischer (1996), this gain is very small and does not justify higher inflation rates. As monetary base is generally a small fraction of GDP, the increase of government revenue due to inflation is not significant in relative terms. Additionally, inflation is known as the unfair of taxes, since not everyone can be protected against its adverse effects.

³⁷ The Japanese case is still more difficult, since fiscal policy is also restrained given the large public debt. Economists as Paul Krugman, argue that the solution to the Japanese crisis is to increase the quantity of money in order to produce inflation, and makes the real interest rate negative fostering, therefore, consumption.

5 – A Cost-Benefit Analysis of Inflation: Some Empirical Results

The last two sections have shown several inflation costs and some benefits as well. At this point it is important to verify what the evidences about the net benefits of price stability on social welfare are, that is, what is the cost-benefit associated to low inflation rates. As already seen, there is a consensus that high inflation rates are harmful to economic growth and, therefore, decreases social welfare. Nonetheless, this consensus disappears when one deals with inflation rates compatible with price stability (e.g. 3% or less).

Before analysing the empirical evidence, it is important to stress once again that some inflation costs are very difficult to be measured empirically. This happens despite their clear theoretical importance and the obvious welfare loss associated. This is the case of the costs associated with non-anticipated inflation, more precisely, the loss of economic efficiency provoked by inflation uncertainty. In this regard the allocation cost associated to sub-optimal consumption and investment decisions stand out. The same difficulty arises when measuring the distributive costs, since for each winner there is a loser. Nonetheless, this kind of cost can cause financial crises with serious economic consequences.

In the same way it is difficult to estimate, or even impossible, the welfare loss associated with the extra time and resources needed to deal with the price system distortions caused by inflation. It is hard to know the costs involved in searching better information needed to take correct decisions, and those originated by non-optimal decisions caused by the deterioration of the price system as well. Or yet the costs associated with the need of economic agents to protect themselves against the adverse effects of inflation.

Part of these difficulties stems from the fact that GDP is not a perfect measure of social welfare, which is the relevant concept involved here. For example, it is well known that inflation foster the financial system to grow in relation to GDP. In this case, the

associated cost is, indeed, counted as a benefit in terms of GDP, even though economic resources are diverted, decreasing economic efficiency. In the same way, even assuming that inflation does not affect long-term growth, if it increases economic instability social welfare will certainly decrease, despite the fact that economic growth remains unchanged.

Inflation costs depend on whether inflation is anticipated or not, a hard task to be verified empirically, especially if inflation expectations are highly heterogeneous among economic agents. Generally, empirical studies assume that inflation is perfectly anticipated. When calculating the benefits of disinflation these studies ignore, for example, that two countries with the same inflation rate can have substantially different inflationary risk premia and, therefore, different benefits due to reducing inflation.

In a similar way, it is difficult to estimate some of the allegedly inflation benefits as, for example, the one related to the limitation of reducing interest rates below zero. Moreover, this benefit may not be relevant during extended periods of time. The benefits derived from the grease in the wheels role of inflation are also difficult to gauge, since in a long enough low inflation regime prices could become more flexible.

By its turn, the estimable inflation costs and benefits vary in accordance with the adopted methodology. For example, some estimates are derived from partial equilibrium models while others are originated from general equilibrium models. Furthermore, due to the abovementioned difficulties, empirical studies are able to capture only some of the inflation costs. In this way, obtained results underestimate the true inflation costs. Another important issue concerns whether disinflation costs are considered permanent, as argue some economists (e.g. Akerlof *et alli*, 1996; Fortin, 2001), or temporary, as assume the majority of the economists.

As a consequence, the results about price stability benefits vary a great deal, and there is no consensus about the subject. Today, however, it is known that the raw benefits of inflation are higher than those believed in the beginning of the 90's (O'Reilly, 1998). This fact is due, essentially, to a better quantification of the costs caused by the perverse interaction between inflation and the tax system.

In fact, empirical studies identify this cost as the most significant cost of inflation.³⁸ Feldstein (1996) estimate it using a partial equilibrium model and calculates that reducing (a perfectly anticipated) inflation by two percentage points implies an additional growth of 1% per year for the United States.^{39,40} In a similar study, Bakhshi *et alli* (1997) estimate a smaller gain for England, although yet relevant, 0,2% per year. The benefits calculated by Tödter e Ziebarth (1997) for Germany amount significant 2% per year, due to the high saving rate, high taxation of capital gains and the non-indexed tax system in that country.

According to Briault (1995) the true cost of the adverse interaction between inflation and the tax system is the one derived from adapting the tax system and financial contracts (indexation), and not the loss originated from the above adverse interaction.⁴¹ With regard to the other inflation costs (e.g. shoe leather costs, menu costs, etc...), the estimates show an order of magnitude well below as the ones showed above, despite the big dispersion among estimates.⁴²

Among the inflation benefits, the allegation that inflation makes real wages (and other economic prices) more flexible stands out, i.e. inflation greases the working of the labour market. According to Akerlof *et alli* (1996) this benefit helps to decrease the natural rate of unemployment. In the other hand, by distorting the information provided by the price system, inflation also harms its functioning. In fact, Groshen and Schweitzer (1997a) show evidences that these two effects exist in the labour market in United States. In this way, Groshen and Schweitzer (1997b) conclude that: a) the net benefit of inflation is very small and disappears for inflation rates above 2,5%; b) this result does not allow one to pursue positive inflation rates, but also does not provide evidences about the optimal inflation rate.

³⁸ Despite the empirical evidences show that the most significant cost of inflation stem from the perverse interaction between inflation and the tax system, one cannot state that this is the main cost of inflation. Although hard to measure, it is likely that the costs derived inflation uncertainty are the most important.

³⁹ More specifically, Feldstein (1996) analyses the distortions cause on consumption demand for money, public debt and the housing market.

⁴⁰ More recent studies, which use general equilibrium models, show that the costs can be even higher (e.g. Bullard e Russel, 1999).

⁴¹ This points leads to the discussion about what is the best way of fighting inflation costs: to decrease the inflation rate or to index the economy? Basically, due to the observed difficulties in several countries in this regard (absence or partial indexation), some economists argue that the second option is not viable.

⁴² O'Reilly (1998) presents an empirical survey about several inflation costs.

Nonetheless the absence of empirical studies that compare all costs and benefits of inflation in the same framework (Coletti e O'Reilly, 1998), some studies try to estimate the net benefit (or cost) of price stability. In this case, it is fundamental to determine whether disinflation costs are transitory or permanent.

Using the Quarterly Projection Model (QPM) from the Central Bank of Canada, Black *et alli* (1998) measure the net benefit of price stability for the Canadian economy, comparing the present value of low inflation benefits to the required costs to achieve it and maintain it. The authors consider different hypotheses about the way the economy works, by using different estimates found in the literature concerning specific inflation costs and benefits and adopting different discount rates as well.⁴³

In order to compare and standardize the results of several empirical studies, the authors have created a welfare measure called equivalent variation.⁴⁴ With the aim of considering different hypothesis regarding the way the economy works, they have augmented the QPM. In this way, the model was able to incorporate important characteristics such as labour market hysteresis, fiscal effects of monetary policy and the effects produced by the restriction of zero nominal interest rates.

Black *et alli* (1998) conclude that the benefits of low inflation exceed the costs. Moreover, the authors recognize that their analysis underestimate inflation benefits, since some of the main inflation costs were not considered (e.g. allocation costs).

Bullard and Russell (1999) use a general equilibrium model in order to analyze the welfare loss caused by inflation. The obtained result is well above the results found in the literature: an increase of ten percentage points in inflation provokes an equivalent annual welfare loss of 11,2% of GDP. Once again, the main inflation costs are originated from the perverse interaction between inflation and the tax system.

However, in opposition to previous studies, despite the fact that a rise in inflation increases the effective tax rate and, therefore, increases the difference between capital

⁴³ More specifically, two costs were considered: those derived from the perverse interaction between inflation and the tax system, and those originated from reducing the inflation tax.

⁴⁴ The equivalent variation is defined as the required proportional increase in household consumption each year, in the high inflation equilibrium, so as to they are as well as in the low inflation equilibrium.

gains before and after tax, in this particular case the gain before tax decreases. [e.g. in Feldstein (1996) it is assumed constant].⁴⁵ This factor is the main responsible by the increase in inflation costs, since inflation produces a big effect on the real return of non-monetary assets.

6 – What should be the Long Term Inflation Target for Brazil?

Section 2 has showed that despite the consensus among economists about the concept of price stability, there are difficulties in defining it operationally. Nonetheless, one can say that there is a consensus that inflation rates above 3% are not compatible with the concept of price stability. Therefore, it can be said that the 0%-3% interval reflects the “size of disagreement” among economists. Having said that, the relevant question turns out to be: what rate of inflation the central bank should aim within the above interval? Or put in a different way: what is the optimal rate of inflation?

Despite the advances in the measurement of inflation costs and benefits in the last years, it is still not possible to reach a consensus in this regard. Indeed, as Mishkin and Schmidt-Hebbel (2000) alert, the optimal inflation rate is still an unresolved issue. Basically, this situation can be explained by two factors: a) despite its importance, several inflation costs are hard to measure as, for example, those provoked by inflation uncertainty, especially the allocation costs. The same occurs concerning distributive costs, since the loss of one individual is equal to the gain of another individual. It is also difficult to measure some costs originated by living with inflation (e.g. the time and resources spent with price search); b) the costs of inflation depends on institutional characteristics, as the degree of indexation of the economy and the rigidity of the labour market.

Furthermore, as already mentioned, there is a great discrepancy in inflation costs estimates. This difference is partially explained by the fact that different economists use different methods and techniques to gauge these costs. For example, while some

⁴⁵ That happens since the authors consider that the government decreases the amount of resources borrowed from the public, resulting from the higher tax collection due to inflation [in Feldstein (1996), the government decreases the tax rate of other taxes).

economists use partial equilibrium models others use general equilibrium models. Nonetheless, it is possible to draw some conclusions about the optimal inflation rate.

First, since inflation is not precisely controlled by central bank, the inflation target should encompass some kind of interval.⁴⁶ Second, “the size of disagreement” about the operational definition of price stability together with the estimated costs of inflation, suggest that the optimal central target should be less than 3%. In fact, there are several empirical evidences which show that the cost-benefit of reducing inflation is positive and high, even considering low inflation rates (Feldstein, 1996; Black *et alli*, 1998; O’Reilly, 1998, Bullard e Russell, 1999).⁴⁷ Moreover, it should be stressed that empirical studies take into account only some inflation costs. Third, inflation costs and benefits depend on institutional factors (e.g. tax legislation) and structural factors (labour legislation). In the same way, the size of inflation measurement bias is different for each country. These facts show that it does not make sense the idea of an optimal inflation rate for all countries. Fourth, the recent economic performance of several countries shows that it is worthy to pursue low inflation rates.

Table 1 shows that the average inflation rate for nine industrializes countries, in the last five years, was below 2,7%. By its turn, Table 2 shows the long run inflation targets for nine countries which adopt the inflation targeting regime and for the European Central Bank. With the exception of Chile and Israel, the upper interval bound is not higher than 3%.⁴⁸ In the same way, Chile and Israel are the only countries that have central targets equal or above 3%.

These evidences are in accordance with the above analysis, at least when deals with industrialized countries, but is also raise one question. Why Chile and Israel have adopted higher inflation targets? According to Mishkin and Schmidt-Hebbel (2000), the inflation target for rapid growing countries, a common characteristic of several emerging countries, should be slightly above of those targets for industrialized countries.

⁴⁶ The interval may be explicit, as in the majority of countries, or implicit, as in England.

⁴⁷ Note that Black *et all* also consider the possibility of hysteresis and other kinds of rigidity.

⁴⁸ Despite the target for England is punctual and equal to 2,5%, if inflation rises above 3,5% the Bank of England is obliged to issue an open letter explaining the motives why the target was breached. The same occurs if inflation falls below 1,5%. In this way, one can say that the superior (implicit) bound for

Table 2
Inflation Targets for Several Countries

Countries	Target
New Zealand	0%-3%
Canada	1%-3%
United Kingdom*	2,5%
Sweden	1%-3%
Finland	2%
Australia	2%-3%
Spain	2%
Israel	3%-4%
Chile	2%-4%
European Central Bank**	below 2%

* If the inflation deviates more than 1% from the target the Bank of England must explain to the society why the inflation target was not met.

** Despite the fact that the ECB does not adopt an inflation targeting regime, it has as its main objective inflation rates less than 2%.

The reason, according to the authors, is based on the fact that rapid growing countries experience an appreciation of the real exchange rate. This appreciation is proportional to the relative difference between productivity growth in the tradable and non-tradable sectors of the economy, in relation to the rest of the world (Harrod-Balassa-Samuelson effect).

The classical example of this phenomenon is Japan, which experienced a long period of strong economic growth and appreciation of the real exchange rate. Note however that, several other rapid growing countries, as Brazil until 1980, did not experience this kind of phenomenon.⁴⁹ In other words, this fact cannot be taken for granted. And, more importantly, it should be stressed that there is no direct implication between real exchange rate appreciation and the value of the inflation target for rapid growing countries. Actually, the authors' argument translates essentially a policy choice regarding the future path of the nominal exchange rate. Actually, given inflation's adverse effects this option does not seem to be the most adequate.

Real exchange rate appreciation may occur due to two motives: the internal inflation rate is higher than the external one, or the fall of the nominal exchange rate. Therefore, there is no real need why rapid growing countries should adopt an inflation target above

England is above 3%.

⁴⁹ Brazil was one of the countries that grew more in the world between 1940 and 1980, 6,4% on average per year.

external inflation, unless due to an economic policy choice. If internal inflation is higher than external inflation and if, indeed, Harrod-Balassa-Samuelson effect comes into play, the nominal exchange rate will remain constant or will depreciate less than the difference between internal and external inflation. However, if internal and external inflation rates (targets) are equal, the real exchange rate appreciation will occur through the falling of the nominal exchange rate.

Besides the path of the nominal exchange rate, there are two other relevant implications regarding the choice of a higher internal inflation target. First, a higher inflation rate means lesser social welfare and credibility for the central bank. Second, if internal and external inflation are equal, the real exchange rate appreciation (assuming the Harrod-Balassa-Samuelson applies for a particular country) will be determined by market forces. By the other hand, by choosing a higher inflation target the government assumes a priori that this effect will happen with certainty (which may indeed never happen) and choose through which channel this effects will affect the economy (e.g. via higher inflation and not via nominal exchange rate appreciation).

Table 3
Long Term Inflation Target

Poole (1999) [*]	0%
Meltzer (1997)	near 0%
Feldstein (1996)	0%
Fischer (1996)	2% (1% - 3%)

* Abstracting from inflation measuring problems.

Table 3 shows what should be the long-term inflation rate according to some economists.⁵⁰ Once again, one does not observe inflation targets above 3%. Moreover, three of them support the view that the long-term inflation rate should be near zero.

⁵⁰ William Poole and Tomas Meltzer are, respectively, president and former president of the Federal Reserve Bank of Saint Louis.

7 – Conclusion

Inflation is an old subject of economists' interests, however controversies about its economic effects still remain, especially in relation to the net benefits of low inflation. Indeed, despite the findings of several empirical studies showing the existence of a negative long run relation between inflation and economic growth, there are yet no robust evidence that this relation holds for low inflation rates (i.e. below 10%). Even though, there is consensus amongst economists and central bankers that price stability should be the overriding objective of monetary policy.

This apparent paradox is justified, among other factors, by the sharp evolution of the literature about the costs and benefits of inflation in the last ten years. Note that, differently from the abovementioned studies this literature has another approach, since its main focus is on inflation's microeconomic effects. More precisely, there has been a great development in the identification and measurement of the adverse effects derived from the interaction between inflation and the tax system. By the other hand, some arguments in favour of "some" inflation have also gained terrain in the same period.

In this way, despite the current consensus about the benefits of price stability, there still remains undefined what should be the long-run inflation rate and, more specifically, what is the optimal rate of inflation.

The empirical difficulties associated to the determination of the cost-benefit of price stability stem, among other factors, from the absence of long periods of low inflation. This fact is particularly relevant, since several studies show that the benefits of price stability are permanent but materialize themselves slowly over time. By the other hand, the costs of reducing inflation are high and take place in short periods of time. Often, this situation enables people to have a myopic view about the real effects of inflation and how it affects social welfare.

Another difficulty stems from the fact that some inflation costs are counted as benefits. For example, inflation fosters the growth of the financial system in relation to GDP. This fact makes one be aware that GDP is an imperfect measure of social welfare.

Another very important factor is that some of the inflation costs are very hard to measure empirically. For example, this is the case of the higher cost involved in decision making (or the existence of sub-optimal decisions) due to the deterioration of the price system.

The existence of tax systems that are not perfectly indexed to inflation causes undesirable consequences to the economy, since whenever there is inflation there is an increase in the effective tax rates. This happens to the income tax, since whenever the income tax table is not corrected by inflation the effective tax rates for all income levels increases, decreasing people's available income and, therefore, decreasing consumption and GDP. As seen, the imperfect indexation of the tax system also affects adversely investment and saving decisions.

One can say, therefore, that inflation acts, at the same time, as a direct tax (inflationary tax) and an indirect tax (increasing the effective tax rates of other taxes). Besides, inflation is the most unfair of taxes, since it affects with more intensity the poorer, which have fewer resources to protect themselves against its undesirable effects.

Among inflation costs those stemmed from inflation uncertainty stand out. Despite the difficulties in measuring them empirically, the literature shows that they are at least as important as those derived from the perverse interaction between inflation and the tax system. Inflation uncertainty harms resource allocation and decreases economic efficiency. It also increases interest rates affecting adversely investments, mainly long-run investments. In some cases, some markets disappear because of inflation uncertainty. The increase of interest rates also raises government spending with public debt services.

Despite empirical evidences show that inflation level and inflation uncertainty are positively correlated, inflation uncertainty can remain high for long periods despite low current inflation. This happens, basically, because low current inflation does not mean, necessarily, low future inflation. In this way, it is essential that the central bank gain credibility by searching price stability, maintaining inflation uncertainty low. Besides that, it is essential the existence of institutional arrangements that minimise political influences on monetary policy and the uncertainties stemmed from government

transition as well.

Since credibility is an asset that is difficult to obtain, the real benefits of price stability usually need long spells of low inflation to take place. This fact, together with several and significant costs derived from inflation uncertainty, shows that the concept of price stability must encompass not only low and stable current inflation rates but mainly low and stable inflation expectations regarding the future. Only when these two conditions exist at the same time is that society can profit from all benefits arising from an environment of price stability.

Regarding the arguments in favour of “some” inflation, the main one is that inflation greases the working of labour market, easing the fall of real wages since nominal wages are usually rigid downwards. As a consequence, very low inflation rates can increase permanently the equilibrium unemployment rate.

This argument is controversial empirically, since different studies reach different conclusions, and theoretically as well, since some economists argue that price rigidity would not exist in a true price stability regime. Moreover, the recent experience of countries such as the United States and England have shown that low inflation rates do not imply, necessarily, an increase in unemployment rates. Indeed, in those countries the fall of inflation have happened together with the fall in unemployment rates.

Another two arguments in favour of “some” inflation refer to the existence of a positive bias in the measurement of inflation and to the loss of degrees of freedom in the conduct of monetary policy when inflation is very low.

Concisely, currently one knows that inflation costs are higher than was thought in the beginning of the decade of 1990, and that many of these costs are very hard to be measured empirically. Indeed, there are well established theoretical reasons which show why inflation and inflation uncertainty decrease social welfare, regardless of the empirical difficulties found. And, despite the consensus about the desirability of price stability, it still remains controversies regarding the net benefits of low inflation.

Actually, the issue of the optimal rate of inflation is yet to be resolved. Nonetheless, the available evidences allow one to draw some conclusions: a) the net benefits of reducing inflation seem to be high, even when inflation is low; b) the costs and benefits of inflation depend on economic and institutional characteristics of each country as, for example, the degree of indexation of the economy and the flexibility of the labour market; c) the main central banks around the world have been pursuing long term inflation targets around 2%. However, since inflation is not controlled precisely in the short-run, the usual interval aimed is between 1% and 3%.

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