BANK OF CANADA
BANQUE DU CANADA

Discussion Paper/Document d'analyse
2007-6

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Bank of Canada Discussion Paper 2007-6

July 2007

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ISSN 1914-0568

Acknowledgements

The authors wish to thank, without implication, Allan Crawford, Scott Hendry, Pierre St-Amant, and participants at the BIS Autumn Central Bank Economists' Meeting, 30–31 October 2006, for helpful discussions and comments.

Abstract

The authors analyze the extent to which inflation-targeting frameworks should incorporate flexibility in order to respond to asset-price misalignments and other atypical events. They examine the costs and benefits of adding flexibility to the Bank's current inflation-targeting framework, and conclude that maintaining low and stable consumer price inflation is the best contribution that monetary policy can make to promoting economic and financial stability, although some flexibility in the target horizon may allow monetary policy to deal appropriately with asset-price bubbles and other atypical events. The authors suggest that monetary policy may, in principle, be better able to maintain low and stable consumer price inflation by leaning against an asset-price bubble (even though it may mean that inflation deviates longer than usual from its target), when such an event is well identified and likely to have significant real economic effects. This circumstance is likely to be rare in practice, however, because economists are far from being able to determine consistently and reliably when leaning against a particular bubble is likely to be successful. The authors also describe ongoing Bank research to better understand the transmission of asset prices to the real economy and the interaction between asset prices and optimal monetary policy.

JEL classification: E5, E6
Bank classification: Monetary policy framework; Inflation targets

Résumé

Les auteurs analysent le degré de flexibilité dont devrait jouir le régime de cibles d'inflation pour pouvoir faire face aux déséquilibres de prix sur le marché des actifs et autres phénomènes atypiques. Au terme de leur examen des coûts et des avantages qu'il y aurait à assouplir le régime actuel de cibles de la Banque, ils concluent que le maintien du taux d'augmentation des prix à la consommation à un niveau bas et stable constitue la meilleure contribution que les autorités monétaires puissent apporter à la promotion de la stabilité économique et financière. Ils notent toutefois que le fait de disposer d'une certaine latitude à l'égard du délai prévu pour ramener l'inflation à la cible peut aider les autorités à faire face aux bulles d'actifs et autres phénomènes atypiques. Les auteurs avancent que la politique monétaire pourrait, en principe, être mieux en mesure de maintenir la hausse des prix à un niveau bas et stable en intervenant à contre-courant du marché (même au prix d'écarts plus durables que d'ordinaire du taux d'inflation par rapport à la cible), lorsqu'une bulle d'actifs a été clairement décelée et que son éclatement est de nature à avoir d'importantes retombées économiques réelles. Ce cas est cependant rare en pratique, car les économistes sont loin de pouvoir établir de manière systématique et fiable dans quelles conditions

le fait d’agir à contre-courant du marché a de bonnes chances de réussir. Les auteurs décrivent également les recherches en cours à la Banque sur le mode de transmission des prix des actifs à l’économie réelle et sur l’interaction entre ces derniers et la politique monétaire optimale.

Classification JEL : E5, E6
Classification de la Banque : Cadre de la politique monétaire; Cibles en matière d’inflation

1. Introduction

How much flexibility does an inflation-targeting (IT) framework need in order to respond appropriately to asset-price bubbles and other atypically uncertain and persistent events that may disrupt the financial system and the economy?[1] Starting with the Canadian IT framework as a point of reference, this paper draws on recent research conducted at the Bank of Canada and elsewhere to address this question.

Canada's experience with inflation targeting has shown that the rules embodied in the IT framework have improved the conduct of monetary policy by enhancing its commitment to inflation control, as predicted by theory. One important characteristic of the Canadian framework is the early return of inflation to target, within six to eight quarters, which enhances the target's credibility. However, at some point in time, the economy could experience a persistent shock with a highly uncertain impact on the economy—for example, an asset-price bubble. In the face of such a persistent and uncertain shock, it may be appropriate to pursue the inflation target less vigorously in the short run, in order to dampen the longer-run volatility produced by the shock. More flexibility than is in the current IT framework would be required to accommodate such a policy response.

The Canadian IT framework is similar to that found in most inflation-targeting countries, in that it is flexible in the timing and size of policy reactions to changes in inflationary pressure (Paulin 2006). This flexibility helps monetary policy deal with the variability of most shocks, but it is likely not sufficient to deal with shocks that have uncertain and persistent effects on output and inflation that may extend well beyond six to eight quarters. Our research, as well as that of others, shows that large booms and busts in asset prices can have especially persistent effects on output and inflation. Moreover, current policy models are not capable of predicting these effects, because research has not articulated the causes and behaviours associated with asset-price boom-bust cycles, despite the significant progress that has been made at the Bank and elsewhere in modelling the financial channels through which asset prices work. As a result, structural macroeconomic models are not yet able to give the same guidance to policy on how to respond to an asset-price shock as they give for other shocks. This limitation of policy models reinforces the need to add flexibility to the IT policy framework, so that it might better deal with asset-price shocks.

1. The terms "bubble" and "misalignment" are used interchangeably to refer to any large and persistent boom in asset prices that is followed by a bust and that is likely to entail an asset price deviating from its fundamental value.

The narrow target horizon constrains the flexibility of monetary policy most in the face of a large and persistent asset-price shock with highly uncertain and incompletely predicted effects. More flexibility in such a circumstance could allow policy to achieve significant gains in the form of reduced output and inflation volatility by allowing the inflation-target horizon to stretch beyond six to eight quarters (Coletti, Selody, and Wilkins 2006). A longer horizon, as a number of economists suggest (e.g., Bean 2003; Selody and Wilkins 2004; White 2006), would give policy more scope to lean against an asset-price bubble to restrain its size and/or limit the overspending and financial imbalances that tend to accompany such shocks. Such flexibility could enhance the effectiveness of the IT regime by muting the long-run negative consequence of asset-price bubbles. There are other ways to enhance flexibility—such as an escape clause that would allow the authorities to deviate more substantively from the IT framework under predetermined conditions—but at some point too much flexibility is unhelpful, because it can severely weaken the perceived commitment of the central bank to the inflation target.

The Bank's research on this issue has focused mainly on three questions: (i) Can the effect of asset prices on output and inflation be predicted reliably with sufficient lead time? (ii) Does adding the financial channel to structural macroeconomic models alter the appropriate monetary response within the current framework? (iii) What is the optimal inflation-target horizon in the presence of asset-price bubbles?

This paper is organized as follows. Section 2 motivates the need for flexibility within the context of an IT framework. Section 3 discusses how asset prices are modelled at the Bank, and describes the results of some recent research to improve our understanding of the transmission mechanism and the indicator properties of asset prices. Section 4 discusses the implications of asset-price bubbles for the optimal IT horizon. Section 5 describes the limits of flexibility. Section 6 concludes and describes ongoing research at the Bank.

2. The Need for Flexibility

The rules embodied in an IT framework enhance the commitment of a central bank to inflation control and thus add to the credibility of monetary policy. In Canada, there is considerable evidence that this credibility increased significantly with the introduction of the IT regime in 1991. Johnson (1998), Perrier (1998), and Perrier and Amano (2000) analyze survey data to show that the credibility of monetary policy in Canada has increased since inflation targeting was introduced. St-Amant and Tessier (2000) find evidence that inflation expectations became less responsive to inflationary shocks following the adoption of inflation targeting. This evidence is compelling, but may not be conclusive, given the possibility that inferences from survey data

could be confounded by actual inflation being low for reasons unrelated to increased central bank credibility. The survey data could be a simple function of this past data. This alternative interpretation is unlikely, given findings by Levin, Natalucci, and Piger (2004) that private sector long-run inflation forecasts in Canada fail to exhibit significant correlation with lagged inflation over the same period. The same result is found for four other major economies that maintained explicit inflation objectives over the same period.

Despite the success of Canada and many other countries in attaining persistent low inflation, there is evidence that asset-price swings have been greater in recent business cycles than in previous cycles (Borio and White 2004). One hypothesis is that monetary policy regimes that attain low and stable inflation can increase the probability of asset-price bubbles forming because the low nominal interest rates associated with low inflation can fuel excessive optimism about the ability of firms to capitalize on the future profits from new technology.

Of course, the inappropriate implementation of monetary policy, possible even with high-credibility IT regimes, can contribute to the formation of an asset-price bubble. Eichengreen and Tong (2003) study a century's worth of data from 12 countries (including Canada), and show that asset-price volatility is highly correlated with volatility in the monetary policy regime. If the increased credibility gained from inflation targeting is used to maintain inappropriately low nominal interest rates (that do not trigger inflation, because inflation expectations are well anchored by high credibility), then asset prices may be the outlet for the excessively easy credit.

Thus, asset-price bubbles can occur when credit is easily available, even if the IT regime is credible. Several empirical studies find a correlation between excessive credit growth and asset-price bubbles. For example, Bordo and Jeanne (2002) examine post-1970 data for stock and property prices from 15 countries that are members of the Organisation for Economic Co-operation and Development (OECD), and observe that credit growth was unusually strong during the 20 asset-price booms reflected in the data. In a similar study using aggregate asset-price data from 18 OECD countries since the 1970s, Detken and Smets (2004) find that, where real money and credit growth are particularly strong, high-cost asset-price busts tend to follow asset-price booms. Borio and Lowe (2004), in a study of 34 countries from 1960–99, also find that excess credit and asset-price cycles often occur in tandem.

These observations are consistent with the hypothesis that errors in monetary policy can arise when asset-price bubbles are excluded from the models used for monetary policy advice and not incorporated in judgment. Ignoring the possibility of asset-price bubbles means that monetary policy may not give sufficient weight to the long-run consequences of excessive credit growth.

Policy would therefore remain easy for too long, contributing to a highly persistent boom-bust cycle in asset prices that would add unnecessary volatility to inflation and output at horizons longer than the typical inflation-target horizon.

In our view, an IT regime is the best monetary policy regime for reducing the probability that asset-price bubbles will develop. Inflation targeting provides a stable environment in which nominal profits are easier to predict, thus improving the ability of rational arbitrageurs to estimate the fundamental price of assets. Asset-price bubbles can complicate the job of monetary policy because they can add volatility at long horizons. They differ from many other more usual shocks (e.g., demand shocks, commodity price shocks), making them difficult to model. Although it is easy to describe the channels through which a bubble can impose costs on the economy, it is not easy to predict when these costs will arise, because the endogeneity and forward-looking nature of asset prices make it difficult to determine how asset market participants might be misreading the future economy. Furthermore, each boom-bust episode in asset prices is unique, limiting the usefulness of summary statistics and "stylized facts" in calibrating models and predicting the future. In fact, not all asset-price booms resulting in busts are associated with long-run volatility (Bordo and Jeanne 2002; Helbling and Terrones 2003). As a result, knowing that a bubble is forming is not in itself sufficient justification for a policy response to the bubble. Moreover, the fickle nature of bubbles suggests that there is much potential for an activist policy-maker to get the timing wrong, thereby making matters worse (Laidler 2004; Stockton 2003).

Thus, asset prices can have significant long-run effects on the economy, but these effects are highly uncertain and difficult to model. The IT framework needs flexibility to deal appropriately with shocks of this nature.

3. Asset Prices in Bank of Canada Policy Analysis

Policy analysis at the Bank of Canada takes into account movements in asset prices in many ways. Fundamental asset-price values are implicit in the calculations that determine the value of wealth in the main structural models used for policy advice, and asset-price movements have a direct effect on the CPI.[2] Analysis of the evolution of market-determined asset prices in the

2. In particular, house prices are incorporated in several components of Canadian core CPI, and therefore direct effects are taken into account in structural policy models.

context of potential misalignments is included in the regular briefings to policy-makers ahead of policy decisions. But asset-price bubbles are not a formal element of the Bank's policy models.[3]

Indicator and monitoring models that use market-determined asset prices are being developed for policy advice. To date, linear indicator models using asset prices as leading indicators of output and inflation tend to be unstable and are therefore of limited use for policy analysis. Non-linear models using simple measures of asset-price misalignments, however, are more promising, but they are underdeveloped.

3.1 Structural policy models

The Bank of Canada's main policy model is ToTEM (Terms-of-Trade Economic Model), a multi-sector, open-economy, dynamic general-equilibrium model of the Canadian economy (Murchison and Rennison 2006). ToTEM assumes an important role for nominal-wage rigidity and a somewhat smaller role for price rigidities to generate persistent real effects from monetary policy actions in the short run. In addition, gradual, hump-shaped inflation and output dynamics are generated for most shocks through a combination of habit formation in consumption, costly adjustment of investment, and variable capital utilization.[4] Asset prices are assumed never to deviate from the rational expected value of the future income flow generated by the asset, and hence asset-price bubbles can never form.

Thus, ToTEM is missing the effects of changes in market-determined asset prices that do not reflect fundamentals—asset-price misalignments—and that may be perceived as persistent and important by economic agents. ToTEM is also missing the effects that movements in asset prices, whether they are fundamentally based or not, may have on the ability of households and firms to obtain credit.[5] The importance of these effects is ultimately an empirical question, depending in large part on how economic agents perceive asset-price changes, and on the ability of households and businesses to use their portfolios as collateral. One would also expect that the magnitude of these effects would vary with the financial structure of the economy. While not much empirical work for Canada has focused on this question, recent evidence suggests that property prices are positively correlated with the availability of household credit across countries (including Canada), pointing to an active credit channel (Hofmann 2001). The importance of this

3. See Macklem (2002) for an outline of the information used in monetary policy decisions.

4. ToTEM has been parameterized to replicate some of the key unconditional moments of the Canadian macroeconomic data over the 1980 to 2004 period.

5. Asymmetric information gives rise to adverse selection and moral hazard problems. In this case, banks require borrowers to offer collateral to back a loan (Bernanke, Gertler, and Gilchrist 1999).

channel in Canada and the United States may have grown in recent years with the advent of home equity financing.[6] One would also expect that the unique characteristics of the credit channel would be more prominent, and therefore more relevant to monetary policy, in the presence of large asset-price misalignments.

Credit channels have been modelled extensively in the literature (e.g., Bernanke, Gertler, and Gilchrist 1999; Iacoviello and Minetti 2000). A model of the Canadian economy with a financial accelerator in both the household and business sector is being developed at the Bank (Christensen et al. 2007). An early version of the model, with the accelerator in the household sector only (Basant Roi and Mendes 2007, hereafter BRM), belongs to the same class of models as ToTEM and tracks the data well along certain dimensions. BRM's model is not as well developed as ToTEM along certain margins, and hence it is not yet used on a regular basis to inform policy decisions. However, it features financial frictions that can work through household balance sheets that are not incorporated in ToTEM, and therefore it can give insight into how the financial accelerator might affect the economy. The financial frictions in the model affect the cost of mortgage financing and allow for monetary policy to affect output through a credit channel. For example, in the face of a positive shock to house prices, the initial increase in the value of houses reduces the mortgage finance premium, stimulating borrowing and aggregate demand, including housing demand. This causes a further increase in house prices, which lowers the mortgage finance premium further. A self-reinforcing boom then emerges, with increases in house prices supporting stronger demand, and sustaining, at least for a while, optimistic expectations for the future.

3.2 Statistical indicator models

Monetary policy is necessarily forward looking. This means that policy should react to asset-price movements only to the extent that asset prices have predictable effects on future inflation. Thus, much of the research into how to respond to asset prices focuses on the usefulness of asset prices in signalling future economic developments.

Some researchers find that information useful for monetary policy can be extracted from housing and equity prices using linear methods.[7] For example, Goodhart and Hofmann (2000) report that housing prices have leading-indicator properties for inflation in 12 countries. Work on a financial

6. The advent of home equity loans has also offset the fact that housing wealth is less liquid than stock market wealth, and subject to higher transactions costs.

7. Performance measures are typically based on comparisons of out-of-sample forecasts at different horizons relative to a simple autoregressive model.

conditions index (FCI) for Canada, which includes housing and equity prices as well as other financial prices, provides evidence of leading information for output at some horizons, but not for inflation (Gauthier, Graham, and Liu 2004). In an earlier study, Cozier and Rahman (1988) document a significant relationship between stock prices and economic activity in Canada.[8]

However, the empirical evidence to date suggests that the information content of asset prices in general, and equity and housing prices in particular, is very modest. In assessing, with linear methods, the relative information content of 38 indicators from seven developed economies, including Canada, Stock and Watson (2003) find that the predictive power of asset prices for output growth and inflation varies between countries, and tends to be unstable over time. Cecchetti et al. (2000) and Filardo (2001) show that the inclusion of housing prices does not improve inflation forecasts in an economically significant manner. Tkacz and Wilkins (2006) find that housing prices significantly improve the forecasting performance of simple linear indicator models for Canadian GDP, but that forecasts of inflation are not improved by the addition of either housing or equity prices. Dufour and Tessier (2006) show that there is a potential role for stock returns to predict inflation.

There exists some empirical evidence of non-linear relationships between economic growth and measures of misalignments in asset prices, although this literature is in its early days and focuses more on equity markets than on housing markets. Studies of non-linear relationships tend to focus on the unusual (or irregular) movements in asset prices. For example, Bradley and Jansen (2004) study whether unusual changes in stock returns (and excess returns) have any information for U.S. output over the 1934 to 2002 period. They reject linearity and find interesting threshold effects, although out-of-sample forecasting is poor relative to the linear model, owing to overfitting. Chauvet (1998–99) tests numerous stock market factors (e.g., excess stock returns, S&P500 dividend yield) as predictors of business cycle turning points, and finds that stock market factors perform better than typical business cycle indicators, even in real time. Borio and Lowe (2004) find a significant relationship between several measures of financial imbalances and banking distress, as well as output and inflation declines up to four years ahead.

For Canada, Tkacz and Wilkins (2006) find significant threshold effects between housing and stock prices and output growth over the 1981 to 2004 period. The non-linearities seem most pronounced at the four- and eight-quarter horizons, and in some instances substantially reduce the forecast errors over the 2000 to 2004 period. Asset prices in the models generally provide

8. Pichette and Tremblay (2003) find evidence of a significant wealth effect of housing on consumption in Canada, but only weak evidence of a stock market wealth effect.

significant value-added to the forecasting performance for output growth, and, to a lesser extent, for inflation, over and above the output gap and the yield spread for the four- and eight-quarter horizons. While these prices generally add some value at longer horizons (three years), the forecasting performance of the models is poor at longer horizons.

Overall, the evidence suggests that normal (or regular) fluctuations in asset prices, with the possible exception of housing prices, should not receive a large weight in policy decisions. It also suggests, however, that factoring in abnormal movements in housing and equity prices may improve policy decisions.

4. The Value of Flexibility in the Inflation-Target Horizon

One obvious way to modify the IT framework in order to deal with asset-price bubbles is to add flexibility around the inflation-target horizon, without changing the definition of inflation used for the target: this allows policy-makers to trade off short-term objectives for long-term objectives, thereby achieving better overall target compliance. Extending the horizon in the face of an asset-price bubble allows policy-makers to take into account the long-run volatility associated with some asset-price bubbles. Since asset-price bubbles with large and predictable effects are rare, the extension of the horizon would be rare. The ability to extend the horizon at certain points in time, at the discretion of the policy-maker, constitutes horizon flexibility.

To analyze the added benefit of horizon flexibility, Coletti, Selody, and Wilkins (2006) examine two Bank of Canada studies that subject ToTEM and BRM to an array of shocks that mimic the typical shocks experienced over the past 25 years (Cayen, Corbett, and Perrier 2006; Basant Roi and Mendes 2007). The optimal inflation-target horizon is derived in the context of a quantitative measure of the loss the economy suffers from volatility in output, inflation, and interest rates as a result of following a monetary policy rule that returns inflation to target either too quickly or too slowly. The parameters of the monetary policy rules in the models—which relate changes in the policy interest rate to predicted future deviations of inflation from target and the current state of the output gap—are then varied to determine the inflation-target horizon that minimizes the loss to the economy.[9] This exercise is repeated for a wide array of potential shocks in order to obtain the range of optimal inflation-target horizons.

Given this approach, the choice of the inflation-target horizon is a balancing act. A shorter horizon keeps inflation closer to the target, but at the cost of more volatility in output and interest

9. See Armour and Coté (1999–2000) and Black, Macklem, and Rose (1998) for a review of feedback rules for inflation control.

rates; a longer horizon allows the central bank to miss its inflation target for a longer period, in the interest of greater stability in output and interest rates. The ToTEM and BRM studies show that the optimal inflation-target horizon varies with each shock, and suggest that, on average, the optimal horizon is marginally shorter than previously thought. However, several important sources of uncertainty are inherent in the analysis, such that the point estimates of the optimal inflation-target horizon should be interpreted as being merely indicative. First, the structure and calibration of the models studied are imperfect approximations of the actual economy. For example, asset-price determination in BRM is very stylistic. Second, the pattern of future shocks could be quite different from historical experience. Third, these studies rely on concepts, such as the preferences of policy-makers, that are not easy to put into practice with great precision. In light of this uncertainty, we conclude that a target horizon of six to eight quarters remains appropriate in most instances.

In the context of the models examined, a few rare shocks, such as an asset-price bubble, have unusually long inflation-target horizons. In these rare circumstances, the results suggest that it may be appropriate for monetary policy to take a significantly longer view of the inflation-target horizon.

5. The Limits of Flexibility

An alternative way to adapt the IT framework to deal with asset-price bubbles or other extreme events would be to add—either separately or in addition to a flexible IT horizon—an escape clause to the framework. The escape clause would make explicit those aspects of the agreement that are state contingent. In theory, such an explicit articulation of the state-dependent nature of the IT framework, in advance of invoking the clause, could potentially help maintain central-bank credibility during the transition from one state to the next, and reduce the cost of learning about the transition. Moreover, surprise deviations from the inflation-target agreement have the potential to be costly in terms of lost credibility, which can result in suboptimal economic outcomes as the public hedge their bets about the degree and duration of the deviation.

The recent literature on escape clauses views a rule-based regime and a discretionary regime as two parts of a more complex monetary policy framework. The theoretical models in this literature demonstrate the benefit of precommitting to the complex rule to maintain the credibility of the central bank during the transition from a rule-based to a discretionary regime (Obstfeld 1997; Kasa 2004). Learning costs can be reduced either because agents are not surprised by the shift in regimes or because they can anticipate the shift if the escape clause is sufficiently precise about the conditions of escape. Lohmann (1992) and Alexius (1999) show

that a central bank facing an exogenous cost of abandoning its rule-based monetary policy would optimally choose an escape clause if it anticipated substantially large shocks.

An escape clause may buy credibility when invoked, but at the cost of some lost credibility when it is not in use. Its existence may give the possibility of escape a higher profile than it deserves, and make the central bank appear to be less committed to the inflation target at a time when it requires the public to have confidence in its committment.

Our analysis leads us to conclude that the inflation-target horizon is the most obvious part of the agreement that one would want to alter in the face of an extreme event, since it preserves the essential elements of the current IT framework and requires only a marginal change in that framework. While an escape clause would give the authorities scope to change the IT framework in more fundamental ways in the face of an asset-price shock, it might also make it difficult to convince the public that a move away from the target in the short term would not persist. The escape clause would need to be precise enough to convince the public that it would be rarely invoked, yet vague enough that it could be invoked in unanticipated circumstances. It is not evident to us that such a delicate balance can be effectively constructed.

6. Conclusions

Asset-price bubbles differ from other shocks to the macroeconomy in that they are rare, have persistent effects, and have consequences that are hard to predict. Monetary policy should take a long view when reacting to the consequences of such shocks. The Bank's current IT framework incorporates an inflation-target horizon of six to eight quarters. This horizon remains appropriate in most instances, but may be too short to deal with asset-price bubbles.

Having established the credibility of the IT framework, it may be appropriate to add greater flexibility to the target horizon, so that it can be extended on those rare occasions when the Canadian economy faces asset-price bubbles with likely persistent real effects. Such occasions are rare not only because costly asset-price bubbles occur infrequently, but because economists are far from being able to determine consistently and reliably when leaning against a particular bubble is likely to be successful.

The Bank is conducting ongoing research in this area with the aim of:

- Developing a better understanding of the transmission of asset prices to the real economy and the interaction between asset prices and optimal monetary policy. Work is under way to construct a model with a financial channel in both the household and business sectors.

Early evidence indicates that the joint modelling of these channels is important to the transmission mechanism (Christensen et al. 2007).

- Building elements into structural macro models capable of producing misalignments in asset prices, and then looking again at the issue of the optimal IT horizon.

- Studying optimal policy-making under uncertainty.

The inflation-targeting framework is working well, but ongoing research is necessary to ensure that it continues to be the best monetary policy framework for Canada.

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