Contract Duration and Indexation in a Period of Real and Nominal Uncertainty

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Abstract

A large sample of Canadian union contracts is used to study the determinants of key provisions such as their duration and elasticity of indexation. Over the last two decades the former has doubled and the latter has halved in size. Techniques, which account for the interaction between duration and indexation and a latent elasticity of indexation are used. The period studied (1976-2000) includes high and low inflation and substantial fluctuations in real and nominal uncertainty, allowing these variables to influence contracts. Results suggest that these variables account for the secular and cyclical changes in contract provisions.

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1 Introduction

During the high inflation period of the 1970s and 1980s, a number of theoretical and empirical studies examined the determinants of key features of collective bargaining agreements, such as contract duration and cost-of-living-allowance (COLA) clauses. These studies identified a number of forces that should influence the provisions of contracts: Contract duration and indexation are determined simultaneously, sometimes in theoretical contexts that involve bargaining. Both variables are influenced by probability beliefs about future values of relevant variables, particularly price inflation and real growth. Also critical are the parties' attitudes to risk, their relative bargaining strength, circumstances unique to the firm and the union (product and local labour market conditions and how net incomes from other sources might be affected by the state of nature), and negotiating costs.

Key provisions of wage contracts, such as their duration and their indexation clauses, affect the dynamic response of the macro economy to various shocks. They are also outcomes that are of interest in their own right, given that the union sector remains important in Canada (union membership as a proportion of non-agricultural paid employees is around 30%) and collective bargaining is an essential economic and legal feature of the labour market as currently organised. Extant theoretical treatments of these contractual provisions are complex and the methodological approaches used lead to different predictions regarding the role of variables such as expected inflation and uncertainty.[1] Inductive work has attempted to narrow down the range

[1] See Shavell (1976), Gray (1976, 1978), Azariadis (1978), Canzoneri (1980), Christofides and Laporte (2002), Dye (1985), Card (1986), Ehrenberg, Danziger and San (1983, 1984),

of possibilities and to guide future theoretical endeavours.

Yet, at the empirical level, a number of issues remain open. Studies of the role of nominal uncertainty by Christofides and Wilton (1983), Christofides (1990), Murphy (1992, 2000), Rich and Tracy (2004), and Vroman (1989), suggest that it reduces contract duration, while those by Bils (1990) and Wallace and Blanco (1991) report no effect. Real uncertainty has not been studied as extensively: Murphy (2000) concludes that aggregate real uncertainty lengthens contracts, Kanago (1998) reports a negative, significant, effect on contract duration from increased real uncertainty after 1972, and Rich and Tracy (2004) suggest that aggregate supply (i.e. real) uncertainty reduces contract duration. Kanago (1998) and Vroman (1989) examine empirically relative measures of uncertainty (e.g. the standard deviation of the distribution of future inflation divided by one plus the expected inflation rate), while Davis and Kanago (1997) consider its theoretical underpinnings. Research concerning the role of uncertainty on indexation is less voluminous and not as recent. Ehrenberg, Danziger and San (1983, 1984) find that real (industry) shocks affect positively the incidence and intensity of COLA clauses. They note that inflation uncertainty has a statistically significant, positive, effect only on the intensity of indexation. The more recent US study by Rich and Tracy (2004) considers whether COLA clauses are chosen at all and reports no significant effect of uncertainty on COLA incidence. Murphy (2000) concludes that inflation uncertainty does not significantly affect the

Danziger (1988), Murphy (1992), and Barcena-Ruiz and Campo (2000). These papers suggest a variety of effects for inflation and real uncertainty on contract duration and indexation. In this paper we refer to nominal and inflation uncertainty interchangeably.

incidence of indexation. Thus, considerable diversity exists in the empirical literature concerning the role of nominal and real uncertainty. Turning to the importance of expected inflation, Gray (1978, note 3, p. 3) and Ehrenberg, Danziger and San (1984, Table 1, row 7) argue that fully anticipated inflation should have no effect on indexation. A role for expected inflation *can* be generated in more complex models (Ehrenberg, Danziger and San, 1984, pp. 224-225) and most empirical studies control for it.

To some extent, these ambiguities persist because, with the decline of inflation in the 1980s and again in the 1990s, research on features of labour contracts generally and indexation in particular has practically ceased. Yet, this new regime of low inflation offers a rich context within which to study labour market arrangements. While the secular trend in inflation has been downward, the reduction in inflation has, at times, been very abrupt, generating considerable nominal uncertainty. In addition, two major recessions have generated considerable real uncertainty. These changes should help identify the forces that operate on contract provisions.

Over the last four decades, the duration of Canadian wage contracts has *doubled* and the degree of indexation has been *halved* - see Figure 1 below. It is natural to wonder whether secular and cyclical changes in these variables are related to nominal and real shocks. This is likely given that many of the determinants of contractual arrangements are agent-specific and, possibly, time-invariant - e.g. risk aversion. The Canadian experience of the last three decades provides a unique opportunity to study these forces. A larger sample of contracts than the US studies have relied on, drawn from a longer and richer historical context (1976-2000), can be used. Attention is directed at contract duration and the elasticity of indexation, taking their interdependence into account and addressing the distinction between the incidence and intensity of indexation. Time series techniques are used in a consistent fashion to model expected inflation as well as nominal and real uncertainty.

The results indicate that changes in these variables are largely responsible for the historical evolution of contract duration and indexation: (i) Contract duration and indexation are jointly determined, with longer contracts associated with stronger indexation and *vice versa*, (ii) increased inflation uncertainty reduces contract duration and strengthens indexation, while increased real uncertainty reduces both variables, (iii) the secular increase in contract duration and decrease in the elasticity of indexation are accounted for by the secular decline in expected inflation, while (iv) the cyclical behaviour of the contract duration and the elasticity of indexation is influenced by nominal and real uncertainty, variables that do not have strong secular trends.

Section 2 discusses estimation issues and presents the econometric model used. Section 3 considers the contract data as well as further information that has been appended. Section 4 presents the empirical results, paying particular attention to the role of expected inflation and nominal and real uncertainty. Section 5 concludes.

2 Econometric Specification

Most contracts do not contain a COLA clause and, where one exists, the elasticity of indexation is modest - see Table 1. Thus two conceptually distinct issues, the incidence and the intensity of indexation, need to be considered.

Typically, limited dependent variable techniques are used to study the former,[2] but very few studies have studied the latter.[3] One approach which combines the study of the incidence and intensity of indexation is Tobit, the model used in this paper.

In principle, all provisions of labour contracts are subject to discussion - see Azfar (2000). It is natural to think of contract duration and indexation as jointly dependent and the theoretical treatments of Gray (1978) and Ehrenberg, Danziger and San (1983, 1984) stress this point. Few studies of these contract provisions have taken this issue on board.[4] In this paper, Amemiya's (1979) model is used, permitting consideration of both the jointness of contract duration and indexation and the latent nature of indexation.

A final issue is the treatment of non-contingent nominal wage adjustment which is a major item during contract discussions. An approach that might be followed is that duration, indexation and non-contingent wage adjustment must be modelled simultaneously. However, allowing for a complete interaction among the variables and addressing the incidence as well as the intensity issue, remains a challenge for this literature.[5] Earlier Canadian

[2]See, for example, Estenson (1981), Ehrenberg, Danziger and San (1983, 1984), Cousineau, Lacroix and Bilodeau (1983), Hendricks and Kahn (1983, 1985), Ceccheti (1987) and Bils (1990).

[3]Ehrenberg, Danziger and San (1983) use a Tobit model to study the elasticity of indexation in 855 contracts. Card (1986) studies the marginal elasticity of indexation in a truncated sample. Christofides (1990) examines the *ex ante* average elasticity of indexation using a Tobit model, while Christofides and Stark (1996) consider the *ex post* average elasticity of indexation using Tobit, Probit and truncated regression.

[4]Murphy (2000) and Rich and Tracy (2004) deal with indexation incidence only, while Ehrenberg, Danziger and San (1983, 1984) use single-equation methods.

[5]Murphy (1992) considers the determination of contract duration, noting that wage

work by Christofides (1990) and Christofides and Stark (1996) suggests that non-contingent adjustment is affected by but does not affect duration and indexation.[6] This structure allows for duration and indexation to be considered on their own. Duration is measured as a continuous variable and indexation arrangements are captured by the variable Elasticity - see section 3.1. Dropping the time subscripts t, the basic system is specified as

$$\begin{aligned} Duration &= Elasticity^{*} \cdot \gamma_1 + X_1\beta_1 + u_1 \qquad (1) \\ Elasticity^{*} &= Duration \cdot \gamma_2 + X_2\beta_2 + u_2 \qquad (2) \end{aligned}$$

where the actual value of the elasticity of indexation *Elasticity* is related to its latent value $Elasticity^{*}$ by

$$Elasticity = \begin{Bmatrix} Elasticity^{*} & if \;\; Elasticity^{*} > 0 \\ 0 & otherwise \end{Bmatrix} \qquad (3)$$

Equations (1)-(3) present a simultaneous equation system with one of the endogenous variables, Elasticity*, as a latent variable. Amemiya (1974, 1979), Nelson and Olson (1977), and Heckman (1978) provide techniques for estimating problems of this general nature. Amemiya (1979) reviews some of these and provides the GLS estimator used here. The reduced form equations

adjustment and indexation incidence are endogenous variables that must be instrumented. Rich and Tracy (2004) do not consider non-contingent wage adjustment. Finally, Murphy (2000) embeds a Probit, not a Tobit, model in a simultaneous structure that determines, in addition, contract duration and wage adjustment.

[6] Note that the US work by Murphy (2000) also concludes that wage adjustment does not affect COLA incidence; it has a negative effect, significant at the 5% but not the 1% level, on contract duration.

for *Duration* and *Elasticity** feature prominently in the Amemiya (1979) estimator and, since they are also used for prediction purposes below, they are also provided. In an earlier draft (available on request) results from 2SLS, which ignore the latent nature of the elasticity variable but account for simultaneity, and OLS (duration)/Tobit (indexation), which ignore simultaneity, were also presented. These provided a useful sensitivity analysis but they are dominated by the Amemiya (1979) structural estimates and are not reported. The construction and theoretical role of variables is discussed in the next section.

3 Data and Sources

3.1 The HRDC Data Base

The contract data used for this study is constructed from electronic records provided by Human Resource Development Canada (HRDC) in Ottawa. Each of the observations is derived from a legally binding agreement between an employer and a bargaining unit and documents many of the provisions of the contract. The data base contains 11885 bargaining agreements reached during the period 1976 through 2000. In order to take into account lagged effects, only observations where at least one prior agreement has been negotiated are considered, leaving 9646 observations for 1977-2000. For these, any variable available for the current contract is also available for the previous contract and is indicated by a p prefix.

The HRDC data contain information on a number of variables, including the main variables under study. Duration is defined by HRDC as the difference between the expiry date and the effective date of the contract - Rich and Tracy (2004) consider some of the issues involved in this definition. Descriptive statistics on the variables used are presented in Table 1 - see also the Appendix. Duration has a mean of 25.6 months with a standard deviation of 11.5 months. The COLA provisions in contracts are diverse and complex[7] but they generally describe how the base wage rate should change as some price index evolves. The variable, Elasticity, is defined as the *ex post* percentage change in the base wage rate brought about by the COLA clause in the contract divided by the percentage change in the CPI over the life of the contract - see section 3.3. As indicated below, the GARCH mechanism used to generate inflation expectations is descriptively accurate and supports using the *ex post* wage growth.[8] When an agreement does not contain a COLA clause, Elasticity is set equal to zero. As Table 1 shows, the unconditional mean value of Elasticity is 0.075 with a standard deviation

[7]For a discussion of some of the issues involved, see Card (1983), Hendricks and Kahn (1985) , Kaufman and Woglom (1986), and Ehrenberg, Danziger and San (1984).

[8]Christofides (1990) used an older version of the data where an *ex ante* measure of the elasticity of indexation was available. This is no longer the case. In principle, an *ex ante* measure should be based on the expectation of inflation held by the contracting pair. In practice, this expectation has to be generated and it is typically assumed common to all agents that contract at a particular point in time. Thus, the *ex ante* and *ex post* measures differ only to the extent that pair-specific expectations do not materialize. How expectations are formed, their uniformity among agents and their descriptive accuracy are issues that continue to attract attention. To the extent that GARCH processes, such as the ones adopted below, are readily available and descriptively accurate, their use as expectation-generating devices seem reasonable. An implication of the adoption of common and accurate methods is that the *ex ante* and *ex post* elasticities should be similar.

of 0.257 while, conditional on Elasticity>0, this value for the 1256 contracts involved is 0.579 with a standard deviation of 0.462. The related variable Cola is set equal to unity when the contract contains a formal COLA clause, even when it was not activated,[9] and is equal to zero otherwise. Its mean value is 0.192, indicating that less than 20% of the contracts contain a COLA clause.

Figure 1 shows Duration, Elasticity and Cola averaged over the contracts that became effective in each of the years 1977-2000.[10] As can be seen, Duration increased secularly, more than doubling from its 18-month low in 1978 to its 38 month high in 1998. Figure 1 also indicates a secular decline in the incidence (Cola) and intensity (Elasticity) of indexation. The secular

[9]There are 1854 contracts for which Cola=1 and, for these contracts, the mean value of Elasticity is 0.393 with a standard deviation of 0.467. The mean for this group is lower than that for the 1256 contracts, since the latter includes only contracts for which the indexation trigger was exceeded and the COLA clause generated a positive wage adjustment. The existence of non-activated COLA clauses presents a modelling challenge. On the one hand they have some value to the contracting parties and their existence may influence other outcomes. This suggests modelling the binary decision, rather than the elasticity of indexation. However, some of these COLA clauses would only be activated under extreme inflation conditions. In addition, ignoring the strength of indexation for contracts whose COLA clauses were intended to be operational under more normal inflation conditions would amount to throwing away valuable information We have chosen to proceed along the second route (which covers both the incidence and the intensity of indexation for the contracts with activated COLA clauses) but, in section 4.3, we consider this issue further.

[10]Only four contracts remain for 1977 and, as these are all indexed, the sample average for the Cola series is used (instead of unity) in order to preserve a reasonable scale in Figure 1. Note the difference between the left and the right scales in Figure 1. The incidence and intensity of COLA clauses are highly correlated - see Figure 1.

trends were, in some instances, interrupted by fairly substantial reversals, as, for example, during 1990-1991, when (i) Cola and Elasticity increased dramatically and (ii) the continuous increase in duration (since 1982) was reversed. There is a very evident link between the incidence and the intensity of indexation. This is important because it suggests that the modelling dilemma, discussed in note 9, may be moot. Interactions between Duration and the two indexation variables are more subtle and require conditioning on other variables before they can be discerned. It should be noted that previous-contract values of Duration and Elasticity appear in their respective equations. These variables help identification[11] and, in addition, capture pair-specific fixed effects which are difficult or impossible to measure - e.g. risk aversion patterns. Fixed effect estimation produced similar estimates - see section 4.3.

Another variable included in the HRDC data base is the nominal base wage rate profile in effect during the contract. Given this, and price information that can be appended (see section 3.3), it is possible to construct the average nominal and real wage rates prevailing over the contract. In this paper, previous contract wages, which are exogenous to the current contract, are used and, as Table 1 shows, the nominal base wage rate Pnomwage is, on average, \$13.31 with a standard deviation of \$5.47 over the 9646 contracts. The previous real wage Prealwage has a higher mean as it is deflated by a CPI which has a base of 100 rather late in the sample (in 1992). Another

[11]Since the model below is exactly identified, normal overidentification tests are not applicable. Heuristic tests of the relation between appropriately defined residuals and all the predetermined variables in the system resulted in very low R^2 values, suggesting no concerns. Identification based on further exclusion restrictions is discussed in section 4.3.

variable in the data base is the number of employees covered by the contract (Employee has a mean of 2138 with a standard deviation of 4644); the natural logarithm of this variable, Lemployee, is used. Prealwage and Lemployee proxy workers' bargaining power and may be expected to increase duration and indexation as these outcomes would provide insurance against unforeseen real shocks and inflation respectively. The region (Atlantic, Quebec, Ontario which is the omitted category, Prairie, British Columbia, Territories, and multi-province) and industry (Construction, Transportation, Communications, Utilities, Trade, Education, Health, Services, Other and Manufacturing as the omitted category) in which the firm is located (see Table 1) are included in order to control for regional and industry fixed effects. There arise for a number of reasons: First, labour demand and supply elasticities, which might be expected to vary by region and industry, figure prominently in theoretical treatments. In addition, these dummy variables condition on unobservables that might influence bargaining between pairs. Finally, to the extent that these variables are important statistically, their inclusion permits a clearer statistical definition of the role of primary regressors.[12]

[12]Between 1975 and 1978 an Anti-Inflation Program controlled wages and may have influenced price inflation. Such effects could be captured by the dynamics inherent in the GARCH process, though the overall constancy of the doefficients limits the extent to which this can be achieved. In section 4.3, we present results based on a recursive GARCH procedure, where all coefficients in the process are allowed to change as history allows the sample size to move forward. In that context, possible effects of controls on price formation and the expectations generating process would be captured. We do not study wages, hence the direct effects of the AIP and the subsequent (1981-1982) wage controls program in the public sector will not be of concern. Possible indirect effects of controls on duration and indexation would affect a very small number of observations.

3.2 Other Variables

Given the effective and expiry dates, it is possible to append further variables to the information for each contract. The Consumer Price Index (CANSIM I Series P10000, CANSIM II Series v735739) allows calculation of Prealwage, as well as the inflation rate over various points in the contract. In turn, the latter can be used, in the context of the GARCH procedures below, to generate the expected inflation rate over the life of the contract (Expinf) and the associated, time dependent, variance of inflation (Nomuncert), or nominal uncertainty. Similar procedures can be applied to deviations of the natural logarithm of real GDP from a linear trend to generate the variance profile in the GARCH process, used as an indicator of real uncertainty (Realuncert). Expinf has a role to play in some risk-sharing specifications - see section 1. There is also evidence in Christofides and Laporte (2002) that higher expected inflation leads to more frequent nominal wage adjustments. The reason is that, without more frequent adjustments, the real wage rate will fluctuate unduly, imposing costs on the bargaining pair. If higher expected inflation calls for more frequent non-contingent wage adjustments, it may also lead to shorter contracts; wage adjustments then become part of broader changes that may be appropriate. In the case of contracts that are already indexed because of the nominal uncertainty perceived by the bargaining pair, higher expected inflation may lead to more frequent and intense indexation as agents use mechanisms already in place for uncertainty reasons to smooth the real wage. Thus Expinf may affect duration negatively and indexation positively. The role of uncertainty in the literature was discussed in section

There were no direct restrictions on duration and indexation elasticities at any time.

1. Unless the Danziger (1988) effect dominates, Realuncert should reduce Duration. Nomuncert should increase Elasticity.

Another important variable attached to the data base is the regional unemployment rate, Rurate, prevailing at the time the contract became effective. These rates vary cross-sectionally as well as across time. For instance, in 1988, the unemployment rate was 5.0% in Ontario and 12.4% in the Atlantic region; the variation over time is exemplified by the increase in Ontario's unemployment rate to 10.9% in 1992. Higher unemployment weakens the bargaining power of workers as well as the ability of firms to improve contractual arrangements since it may weaken the demand for its product. It is likely to lead to shorter contracts and to weaken indexation provisions.

3.3 Inflation and Real Processes

A critical aspect of empirical work in this area is the construction of measures of expected inflation as well as nominal and real uncertainty. One approach used by a number of authors is the rolling regression technique which provides estimates of expected inflation and inflation uncertainty.[13] A second approach is based on Engle's (1982, 1983) ARCH or Bollerslev's (1986) Generalized Autoregressive Conditional Heteroscedasticity (GARCH) alternatives to the rolling regression method. These rely on a series' memory

[13] See Christofides and Wilton (1983), Christofides (1990), Wallace and Blanco (1991) and Wallace (2001), for variations along this theme. Rich and Tracy (2004) argue that, for the US, this measure does not perform as well as their alternative survey-Autoregressive Conditional Heteroscedasticity (ARCH) and structural vector autoregressive (SVAR) measures.

and lags, rather than additional regressors, to achieve high descriptive accuracy. While an ARCH model has been used in studies of contract provisions, GARCH models have not.[14] In this paper, GARCH techniques are used to generate expected inflation and nominal uncertainty. A similar process is used to generate real uncertainty based on deviations of the natural logarithm of real GDP from trend. Following extensive testing downward from more general models, an AR(6) regression model with a GARCH(1,1) error process $y_t = \gamma_0 + \gamma_1 y_{t-1} + \gamma_2 y_{t-2} + \gamma_3 y_{t-3} + \gamma_4 y_{t-4} + \gamma_5 y_{t-5} + \gamma_6 y_{t-6} + \varepsilon_t$, where $\varepsilon_t | \Psi_{t-1} \sim N(0, h_t)$ and $h_t = \omega + \alpha\varepsilon_{t-1}^2 + \beta h_{t-1}$, was used to describe $y = \{\pi, gdp\}$, where the inflation rate $\pi_t = 100 \ln(CPI_t/CPI_{t-4})$ and the variable gdp_t is the deviation of the natural logarithm of real GDP from a linear trend; note that real GDP is Cansim series D15721.[15] The implied error variance h_t is time dependent and proxies nominal and real uncertainty when derived from the π and gdp equations, respectively. Figure 2 shows the actual and predicted values of π_t (for the moment ignore the line labelled SOF). Figure 3 shows the actual and predicted values of gdp over the period

[14]Rich and Tracy (2004) use an ARCH model based on survey data to construct a measure of inflation uncertainty. They also use Gali's (1992) SVAR method, in combination with a rolling window as in Friedman and Kuttner (1996), to construct time-varying measures of nominal and real uncertainty. The relation of these to inflation uncertainy is an open question which is addressed in Rich, Raymond and Butler (1992).

[15]Quarterly data availalble over 1946Q1-2000Q3 (1992=100) were used for the inflation process, while data available over 1961Q1-2000Q3 (1992=100) were used for the GDP process. In a benchmark study, Crawford and Kasumovich (1996) review different ARCH/GARCH models for the Canadian CPI inflation series; their results show that a relatively simple fixed parameter GARCH model, such as the one used here, can capture the characteristics of Canadian inflation well.

1977-2000Q3. The fit of the two models is good (the adjusted R-squared is 0.95 and 0.8 for π and gdp respectively) and the implied nominal and real uncertainty variables are plotted in Figure 4. As can be seen by comparing Figures 2 and 4, the general trend in π_t is downward with substantial declines in the early 1980s and 1990s. During these periods of substantially reduced inflation, nominal uncertainty increased dramatically. In Figure 3, gdp naturally hovers around zero but real uncertainty, in Figure 4, jumped dramatically during the recessions of the early 1980s and 1990s. These dramatic swings in nominal and real uncertainty can be expected to impact the incidence and intensity of indexation and contract duration. As a by-product of GARCH estimation, it is possible to forecast π_t one quarter ahead (Expinf). Similar procedures were used for Nomuncert and Realuncert. These variables were assigned to each contract according to its effective date.[16]

A third approach to generating information on inflation and real processes relies on survey measures either directly, as in Vroman (1989) and Kanago (1998), or indirectly, as in Rich, Raymond and Butler (1992). The Conference Board of Canada collects the views of forecasters from the financial sector on, among other variables, future inflation and real gdp growth. These can be averaged to produce an expected inflation variable and the diversity of opinion in these forecasts proxies nominal and real uncertainty - note that the

[16]Note that, though the GARCH process assumes coefficient stability over the sample period, the construction of Expinf, Nomuncert and Realuncert does not allow agents to presume knowledge of more information than was actually available at the time. The inclusion of data from the entire estimation period is avoided in a recursive GARCH variant of our procedure which adds new observations as calendar time moves forward. Results based on this variant are discussed in section 4.3.

last two variables are not precisely analogous to Nomuncert and Realuncert. These forecasts suffer from some conceptual problems. In the early years of this study, the sampling of forecasters was done only once a year in July (allowing considerable actual information to be known when their forecast for the year was recorded) while later sampling was quarterly and was shifted to the beginning of the relevant period. Thus periodicity and the information set used are not consistent throughout the period. Another problem is that the number of forecasters surveyed varies a lot over the period. In 1975, for instance, there were 13 respondents while in 1999 there were 7. Despite these problems, the Conference Board data present an alternative to GARCH and provide a check of robustness. The individual forecasts for each year were used, maintaining an annual periodicity and assigning to each contract the value for the year in which its effective date falls. The SOF line, in Figure 2, shows the expected inflation rate thus constructed. While generally similar to the GARCH measure, it is slower to respond to abrupt changes in the actual information - as might be expected on periodicity grounds.[17] The inflation and real uncertainty variables from the Conference Board data (a graph is available on request) follow the SOF line rather closely and fail to reflect the fluctuations in uncertainty evident in the GARCH proxies of Figure 4 - for descriptive statistics see Table 1.

[17] Similar series based on the Conference Board data were analysed by Johnson (1997, 1999). He concluded that the professional forecasts did not respond as quickly as the actuals following the disinflation of the early 1980s and the announcement of inflation targets in February 1991. These effects are also present in the GARCH series which shows significantly greater forecast than actual values in 1983Q1, in 1991Q2, 1992Q1and 1994Q1.

4 Results and Sensitivity Analysis

4.1 General Findings

Tables 2 and 3 present results for contract duration and indexation respectively. In general, the results conform with the expectations in the literature and, considering the cross-sectional nature of the data, the goodness of fit is satisfactory. Column 1, Table 2, indicates the reduced form results used by the Amemiya (1979) estimator and in Figure 5 below. The discussion here centres on the structural estimates in column 3, Table 2. The coefficient on Elasticity is 1.996 and significant,[18] suggesting that a fully indexed contract would have duration which is longer than an unindexed contract by nearly two months. It should be noted that this effect would be considerably stronger (3.6 months) if estimated using a single equation and OLS (a method that ignores simultaneity) and larger still (5.1 months) under 2SLS (a method that ignores the latent nature of $Elasticity^*$). There is substantial correlation through time in contract duration; the coefficient on Pdur is 0.315 and it has a very small standard error. The negative signs on the industry coefficients indicate that the longest contracts are to be found in manufacturing (the omitted class), while the shortest ones are in education.[19] The Atlantic

[18] Unless otherwise stated, two-tailed hypothesis tests are conducted at the 5% level.

[19] Wallace and Blanco (1991) and Kanago (1998) note that the coefficient on inflation uncertainty may vary by industry. In this sample, results by industry run into the problem of sample size: Dropping the regional fixed effects to avoid singularity and estimating the model for each industry separately, produced negative and significant coefficients for Manufacturing (with a coefficient, coeff/se of -10.06, -2.66), Construction (-29.86, -2.56) and Health (-18.24, -2.84), negative but not significant coefficients in seven industries (Utilities:

provinces have the longest contracts, longer than the omitted class (Ontario) by 5.451 months. The previous real wage and the logarithm of the number of employees are not significant. The regional unemployment rate has the expected negative sign and is significant but its quantitative impact on contract duration is modest. The expected inflation and uncertainty variables all have negative, statistically significant, coefficients which are quantitatively important.[20] Discussion of the importance of these variables is deferred to section 4.2.

Table 3 presents estimates for the elasticity of indexation. The fit of this equation is satisfactory. The interaction between the elasticity of indexation

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-11.33, -0.65; Natural Resources: -3.10, -0.15; Education: -4.43, -0.82; Transportation: -12.73, -0.50; Communications: -24.11, -0.50; Services: -12.31, -1.59; Others: -9.70, -0.93), and a positive but not significant coefficient in Trade (0.71, 0.05). On balance, these results on the role of Nomuncert are consistent with the ones in the main body of the paper. The difference in the size of the significantly negative coefficients may be more apparent than real as the standard errors are now larger. These results are available on request.

[20]Davis and Kanago (1997) argue, on theory grounds, that inflation uncertainty should be entered relative to the expected rate of inflation and Vroman (1989) and Kanago (1998) implement the relative measure mentioned above. The relative formulation need not be in ratio form as long as the expected inflation is conditioned on as well. This is the approach followed in this paper. The ratio form is a constraint that (i) may not hold and (ii) will disguise the separate role of its constituent parts. When Nomuncert is entered as a ratio to $1 + Expinf$, the Expinf effect dominates resulting in a positive, significant, coefficient (7.617) in the duration equation and a negative significant coefficient (-0-978) in the elasticity equation. These results are consistent with the Expinf effects in Tables 2 and 3 and are available on request. A referee notes that, if the correct specification involves *both* the ratio term and an independent Expinf term, then specifying the equation as we have done results in an Expinf coefficient that compounds the effects of the two forces.

and contract duration, evident in the duration equation, is also present in the structural equation of Column 3, Table 3. The coefficient on contract duration (0.028) has intensity and incidence implications which are examined in the next paragraph. In this case, the coefficient based on a stand-alone Tobit equation (which ignores the simultaneity issue) would have been lower (0.020), underestimating the interaction between indexation and contract duration. Thus, using the Amemiya (1979) estimator allows the interactions between duration and indexation to be more correctly articulated. The temporal dependence of indexation on its previous-contract value is statistically significant. Significant industry and regional effects are present here, as in the duration equation: the most heavily indexed contracts are in manufacturing and in Quebec, though the latter is only significant at the 10% level. Unlike the results in the duration equation, the previous real wage has a positive role to play and bargaining units involving more employees have contracts which are indexed more heavily. The regional unemployment rate has a coefficient which is significantly negative. The expected inflation and real uncertainty variables have significant, positive and negative respectively, coefficients; the nominal uncertainty variable has the expected, positive, coefficient but it is not significant - see below. The role of the expected inflation and uncertainty variables is examined in section 4.2.

Column 1, Table 4, repeats the Amemiya (1979) coefficients γ_2 and β_2 (from column 3, Table 3) and presents the marginal effects $F(\bar{z})\cdot coefficient$, and the McDonald and Moffitt (1980) decomposition of the marginal effects into the impact of a change in the variable x_i on (i) the Elasticity above zero, $\partial Elasticity^{*}/\partial x_i$, weighted by the probability, $F(\bar{z})$, of being above zero (this is denoted in Table 4 as the Intensity Effect) and on (ii) the probability of being above the limit, $\partial F(\bar{z})/\partial x_i$, weighted by the expected value of the latent elasticity $E(Elasticity^*)$ (this is denoted in Table 4 as the Incidence Effect). The variable $\bar{z}$ is the standardized mean value of the argument. The figures in columns 3 and 4, Table 4, add up to the complete marginal effect in column 2, Table 4. Columns 5 and 6, Table 4, give $\partial Elasticity^*/\partial x_i$ (the Elasticity* Effect) and $\partial F(\bar{z})/\partial x_i$ (the Probability Effect) respectively.[21] Table 4 reminds the reader that, relative to the coefficients, the marginal effects are muted. Another point of interest in these calculations is that while the Elasticity and Probability Effects are relatively close in size, their weights in the McDonald and Moffitt (1980) decomposition are not. Since the probability of indexation is considerably lower than the conditional expectation, i.e. $F(\bar{z}) < E(Elasticity*)$, the impact of changes in variables on the weighted probability of indexation (column 4, Table 4) is larger than their weighted impact on the degree of indexation (column 3, Table 4). For instance, Pelasticity, the variable with the largest marginal effect of 0.1004, has an Incidence Effect of 0.0844 and an Intensity Effect of 0.0161.

The reduced form equations used in the Amemiya (1979) estimator are of interest in their own right and appear in columns 1 and 2, Tables 2 and 3. They show duration and indexation (the latter is estimated as a Tobit) net of the interactions between the two variables. These equations confirm the role of the regressors discussed above. Figures 5 and 6 summarize the predictions of the reduced form equations for duration and indexation in Tables 2 and

[21]Note that $F(\bar{z}) = 0.084$, $f(\bar{z}) = 0.1543$, $E(Elasticity) = 0.0288$ and $E(Elasticity*) = 0.3428$.

3 respectively. In the case of indexation, Figure 6 plots the unconditional expected values $E(Elasticity) = F(z)[Duration \cdot \gamma_2 + X_2\beta_2] + \sigma f(z)$, where $z = [Duration \cdot \gamma_2 + X_2\beta_2]/\sigma$ and σ is the standard deviation of u_2. The predicted values in Figures 5 and 6 track the actual observations well[22] and are discussed in detail in section 4.2. The model can be used to also predict, using $F(\bar{z})$, the probability of indexation. A comparison of this against a dummy variable indicating whether $Elasticity > 0$, indicates that the Tobit equation performs well - see Figure 7. Note that the variable Cola would lie uniformly above the lines in Figure 7 because of the number of contracts containing COLA clauses which were not activated.

In summary, the interaction between contract duration and indexation is clearly confirmed in the estimates presented. Contract duration is longer when contracts are more heavily indexed and the degree of indexation is likely to be greater in long rather than short contracts. The coefficient for indexation is grossly exaggerated when simultaneity or the latent nature of the elasticity variable are ignored; on the other hand, the impact of duration on the elasticity of indexation is underestimated when simultaneity is ignored. Thus, choice of an appropriate estimator is quantitatively important. The reduced form equations provide predictions which track the actual observations for duration, the unconditional elasticity of indexation and indexation incidence well.

[22] Predictions are made at the individual contract level and are averaged across all contracts that have effective dates in particular years.

4.2 The Role of Expected Inflation and Uncertainty

Figures 5 and 6 summarize the predictions of the Amemiya (1979) model for duration and indexation respectively. Since the variables of particular interest in this study, namely expected inflation (Expinf), nominal (Nomuncert), and real (Realuncert) uncertainty are time-dependent, their influence and that of other time-dependent variables, can be seen in these figures. In Figure 5, the predictions track the actual data very well, capturing both the secular increase and the turning points of the early 1980s and 1990s. The secular increase in the predicted values must be due to the right combination of coefficient sign and regressor behaviour through time and the best explanation involves expected inflation.[23] The five-year average for Expinf was lower by 7.72 percentage points at the end of the sample than at the beginning and, multiplied by the coefficient of -0.967, this produces a predicted increase in contract duration of about 7.46 months over the sample period. Allowing for the long-run amplification of this effect results in a predicted increase in duration of about 11.3 months, the approximate amount shown for the actual data in Figure 5.

While the decline in expected inflation appears to be the best single ex-

[23]Prealwage and Lemployee trend upwards very gently and have positive coefficients which are too small to contribute importantly to the growth in predicted duration. The unemployment rate as well as nominal and real uncertainty are mostly cyclical and hence cannot contribute in a major way to the explanation of the secular increase in duration. It should be noted that the predicted values in Figure 5 reflect the industrial and regional composition of settlements in any particular year. Thus, the discussion in terms of effects through time in this subsection should be thought of as superimposed on an otherwise neutral cross-sectional pattern of settlements.

planation for the secular increase in contract duration, other time-dependent variables contribute valuable detail to the predicted values of Figure 5. For instance, the decline in the predicted duration of some five months between 1990 and 1992 cannot be explained by Expinf which declined from 4.49% in 1990 to 2.95% in 1992. However, the substantial decline in actual inflation during this period generated a sharp increase in nominal uncertainty from 0.18 to 0.56 (about 0.38). This, times the coefficient on Nomuncert in the reduced form equation for duration of -5.093, generates a decline in predicted duration of about two months. The recession also generated considerable real uncertainty, leading to a rise in Realuncert from 9.47 to 16.57; this increase, times the coefficient on this variable of -0.198, contributes another month to the predicted decline in contract duration. Also important during this recession period was the increase in the unemployment rate from 7.84% to 11.14%. Taking the coefficient of -0.34 into account, this 3.3 percentage point increase in Rurate would contribute a decrease in predicted duration of about one month. Between them, these short-run effects reduce predicted duration by the amount shown in Figure 5. The other notable decline in predicted duration, which occurred between 1980 and 1982, was largely due to the substantial increase in real uncertainty from 8.83 to 20.76. This increase accounts (11.93×-0.198) for a 2.4 month decrease in contract duration. While expected inflation and nominal uncertainty were reasonably flat during this period (see Figures 2 and 4), the average value of the regional unemployment rate increased from 7.25% to 10.49%, leading to a 1.1 month (3.24×-0.34) decrease in predicted duration. Thus, the decline in contract duration during the recession of the early 1980s was driven by real factors alone. The tremendous increase in real uncertainty during 1998 (from 12.25 to 22.11) was also responsible for the small dip in predicted duration in that year, a force which was not reflected in the actual data.

Turning to the behaviour of Elasticity through time, Figure 6 indicates a substantial secular decline which is largely the visual product of outliers in 1977.[24] If 1978 is taken as the starting point, Elasticity declined continually from 0.13 to 0.036 in 1998 before increasing to 0.09 in 1999 and falling back to 0.068 in 2000. A number of secular factors, such as the growth over the sample in Prealwage and Pduration, would suggest (given the positive coefficients of 0.009 and 0.013 respectively) changes in the wrong direction. Thus, again, expected inflation, which declined from 8.26% in 1978 to 1.48% in 1998, is left as the only explanation for the secular decline in Elasticity. The uncertainty variables have opposite coefficients so that the 1990-1992 increase in nominal and real uncertainty tends to cancel out. There is a substantial decrease in Elasticity between 1981 and 1982 which is due to real factors alone. Real uncertainty increased from 13.04 to 20.76 and the regional unemployment rate jumped from 7.01% to 10.49%, both leading to declines in the predicted values. During the early 1980s, nominal forces were not substantial. The reader is reminded that the actual and predicted values in all figures reflect the industrial and regional composition of the bargaining calendar, so that some cross-sectional variation is superimposed on all temporal calculations. Cross-sectional variation is responsible for the predicted increase in Elasticity during 1980 and its decrease in 1995.

[24] In 1977, there are only four observations and these happen to have the rather high conditional elasticity of 0.22.

4.3 Sensitivity Analysis

In this sub-section we probe the sensitivity of the main results above in five different directions.

In light of the significance of the expected inflation variable for the secular evolution of duration and indexation, it is important to check how alternatively defined variables might perform in the context of the Amemiya (1979) estimator. As indicated in section 3.3, there are concerns with the quality of proxies that might be constructed from survey data available in Canada. However, these proxies are useful alternatives to GARCH and provide a check for robustness. Results, available on request, are generally not as good when the three survey measures (SOF-Expinf, SOF-Nomuncert, and SOF-Realuncert) replace the GARCH proxies. Most differences are confined to the variables that have changed: SOF-Expinf continues to have a significant, negative, coefficient (-0.508 ($t = -3.340$)) in the duration equation and a significant, positive coefficient (0.093 ($t = 9.071$)) in the elasticity equation; these coefficients are respectively smaller and larger in absolute size than the ones in Tables 2 and 3 but the overall importance of this variable for the secular evolution of duration and indexation is not affected. In the duration equation, the uncertainty variables are no longer significant. In the elasticity equation they are significant and negative, suggesting a perverse effect from inflation uncertainty on indexation (-0.008 ($t = -4.897$)). In the new set of estimates, the unemployment rate is weaker in both equations and not significant in the duration equation. The interaction between duration and indexation is not affected, nor is the importance of the lagged terms in the two equations compromised.

An additional check on the GARCH specification was conducted by adopting a *recursive* GARCH process. That is, a constant sample size that moves forward in calendar time as history unfolds, is used to reestimate the underlying GARCH processes and to construct the GARCH-based variables Expinf, Nomuncert and Realuncert. The underlying GARCH processes, particularly the parameters of the variance equations, do change over time reflecting changing economic conditions and possibly policies such as the ones mentioned in note 12. The three GARCH-based variables are only slightly different, the most notable change being the less jagged appearance of the two uncertainty variables, particularly Realuncert. Estimates analogous to those in Tables 2 and 3 are very similar, with the following notable exceptions: In the duration equation, the coefficient (coeff/se) on Elasticity is now 3.734 (9.26) and the coefficients for Nomuncert and Realuncert are smaller and higher respectively in absolute value (Nomuncert: -2.000 (-2.96); Realuncert: -0.405 (-4.57)). In the Elasticity equation the most noteworthy change is the increased significance of the Nomuncert variable with an essentially unchanged coefficient (0.163 (6.31)). This change highlights more clearly the theoretically important role of inflation uncertainty in driving indexation decisions. The qualitative and quantitative role of Expinf is unchanged in both equations.

The traditional interpretation of the lagged terms involves slow adjustment but, in this context, they may also stand for pair-specific effects that are not captured by available data. In this latter case, it would be interesting to drop the lagged terms and estimate using an explicit first difference (across contracts) specification. To that end, information from agreements two contracts ago is needed given that previous contract information already appears on the right-hand side. The data set was restructured and 7901 observations were left. First-differencing, removes the censoring issue and it is no longer possible to account for simultaneity, given that the lagged terms have been excised. Estimation is, therefore, based on OLS. The results are available on request. They suggest that the interrelation between duration and indexation remains strong and significant. Expected inflation has a negative, significant coefficient in the duration and a positive significant coefficient in the elasticity equation. Inflation uncertainty has an even smaller (algebraically) negative and significant coefficient in the duration equation and the expected positive effect on indexation. In this last respect, this is a change from Table 3. Real uncertainty continues to have negative, significant, coefficients in both equations. Some differences in the results for other variables are discerned but, in general, the main empirical findings of this paper continue to hold in this differenced specification.

The lagged duration and indexation variables also serve to identify the structural equations as specified so far. Ideally, other (valid) exclusion restrictions would also be at work, reducing dependence on the lagged terms for identification purposes. The HRDC data base includes a variable that indicates the duration of negotiations and an indicator of whether the contract was preceded by a strike. When these variables are included in the duration equation in place of the statistically weak previous real wage rate and logarithm of the number of employees (leaving the elasticity equation unchanged), the system is overidentified. The results on the interdependence of duration and indexation, the lagged terms, the role of expected inflation, nominal and real uncertainty, and the regional unemployment rate are unchanged. This alternative specification is not preferred as it includes regressors (the duration of negotiations and the incidence of a strike) that are endogenous.

Finally, we consider the issues raised in note 9. A stand-alone Probit of the variable Cola, which includes non-triggered COLA clauses but suppresses all information on the intensity of activated clauses, yields qualitatively similar results except that Nomuncert and Realuncert are no longer significant. The duration equation does not seem to be qualitatively affected when Cola replaces Elasticity. There is no strong reason to pursue this alternative estimation strategy and it is preferable to include the intensity information for the activated COLA contracts (these constitute 68% of all contracts for which Cola=1) than to discard it in order to account for the fact that some contracts contain COLA clauses (with high triggers). In addition, the Tobit specification for the activated COLA contracts can speak to both the incidence and intensity of indexation.

5 Conclusion

In this paper, a large number of Canadian wage contracts was used to analyze important contract provisions such as their duration and elasticity of indexation. The contracts were arrived at over the period 1976-2000, a period of high, medium and exceptionally low inflation. During this period, the inflation rate declined steadily but not smoothly. The recessions of the early 1980s and 1990s generated not only substantial real but, also, substantial nominal uncertainty. This rich historical context makes it possible to study contracts, using time series methods to generate conditioning variables and econometric techniques that account for both simultaneity and the latent nature of the elasticity of indexation. Results on the latter can be decomposed into effects on the incidence as well as the intensity of indexation. The results obtained accord with theory where definite conclusions are warranted and they help guide future theoretical efforts by supplying stylized facts. Thus, pessimism expressed in earlier work[25] on the correspondence between theory and evidence may be due to the shorter historical period and smaller number of observations.

A very strong feature of theoretical work in this area is the interdependence between contract duration and indexation, a force which is very evident in the data. Indexed contracts are more likely to be long and long contracts are more likely to be indexed. The quantitative measurement of these cross effects requires the use of techniques which account for both simultaneity and the latent nature of the elasticity of indexation. These effects are well-established despite the inclusion in the equations of past duration and indexation practices adopted by bargaining pairs. This previous-contract information conditions for difficult-to-measure fixed pair effects and helps clarify the role of other regressors. Interestingly, when an explicit fixed-effect approach was used instead of the main model, the results obtained confirmed and were, in some respects, even stronger than in the main body of the paper.

[25] Referring to their extensive attempt to check the efficient risk-sharing paradigm, Ehrenberg, Danziger and San (1984, p. 242) concluded that ' ... the results ... were ... mixed and did not provide strong support for the models'.

Of the variables that may proxy bargaining power, the most reliable is the regional unemployment rate. Increases in this variable reduce contract duration and indexation. Significant regional and industry effects suggest that the longest and most indexed contracts are found in manufacturing.

Allowing that the patterns of behaviour in the annual averages plotted in Figures 5 and 6 reflect the bargaining calendar, the model accounts for (i) the dramatic increase in contract duration and decrease in the elasticity of indexation over the period 1976-2000 and (ii) most of the noteworthy short-run deviations in these variables from trend. The expected inflation rate, which declined over the period, is a significant negative force on duration and positive influence on indexation, thus explaining the secular behaviour of the jointly dependent variables. This force remained strong and significant in all the alternative specifications explored in sub-section 4.3. The nominal uncertainty variable has the expected negative influence on duration and its influence on indexation, though consistently positive, has statistical significance which depends on the estimation method adopted. Murphy's (2000, p. 193) conjecture, that the correlation between measures of expected inflation and nominal uncertainty may cloud the influence of each, was checked[26] and does not appear to account for this weakness. In the more elaborate recursive GARCH specification, nominal uncertainty has the anticipated positive coefficient with a coefficient/standard error ratio equal to 6.31. The real uncertainty variable has a negative, significant, coefficient in both the duration and indexation equations. The variation in the uncertainty variables, along

[26]When the expected inflation values attached to the 9646 observations were regressed against the values for nominal uncertainty, the R^2 obtained was 0.083.

with movements in the regional unemployment rate, explain most of the notable short-run fluctuations in contract duration and indexation. In this sense, the hope expressed in the introduction, that a rich historical context may help clarify the role of important variables, is justified.

Regrettably, expectational data from surveys are not as available in Canada as in the US. Data from a survey of forecasters, which have some weaknesses, were used instead of the GARCH measures to check the robustness of these results. The interaction of duration and indexation, the dependence on lagged values and the role of expected inflation clearly hold in this new set of results. The uncertainty variables are clearly weak and this may stem from the fact that the forecasters' uncertainty strongly mimics the mean of future inflation and fails to pick up changes in the inflation and real environments. Another attempt to check robustness relied on estimating equations based on contract first differences. Here, too, the results are more in line with those of Tables 2 and 3 and the inflation uncertainty variable has a significantly positive effect on indexation.

An outstanding challenge for this literature is the incorporation of other contractual provisions into a simultaneous context. This extension may clarify the strong role, found in our results, for expected inflation: In a broader model which also deals with non-contingent wage adjustment, nominal wage change as a regressor in the duration and indexation equations may reduce the role of expected inflation. Work in progress appears promising but does not eliminate an independent role for expected inflation.

Appendix: Data Construction

The following variables are drawn from the HRDC database:

Duration: Difference between expiry and effective date (rounded to the nearest whole month).

Cola: A dummy variable which equals 1 if the contract contains any one of four COLA clause types and is equal to zero otherwise.

Elasticity: The percentage change of COLA wage adjustment divided by the percentage change in the CPI, over the duration of the contract.

Pelasticity: Elasticity for the previous contract.

Prealwage: The nominal wage rate divided by the CPI at the end of previous agreement.

Industry: Dummy variables generated using the Statistics Canada 1970 Standard Industrial Classification code.

Region: Atlantic refers to Newfoundland, Prince Edward Island, Nova Scotia and New Brunswick; Prairie refers to Manitoba, Saskatchewan and Alberta: Territories refers to Yukon and North West Territories and multi-province to contracts which apply to workplaces in a number of provinces.

Lemployee: The natural logarithm of the number of employees in the bargaining unit.

Rurate - Quarterly regional unemployment rate matched by province at settlement date.

The following variables are generated from GARCH processes:

Expinf: Expected inflation generated, from a GARCH (1,1) process describing the inflation rate. It is the average inflation rate forecast one quarter ahead. It is assigned according to the effective date of the contract. Based on the All Items Consumer Price Index (Statistics Canada P100000, 1992=100).

Nomuncert: Inflation uncertainty generated as the one quarter ahead forecast of the conditional variance from a GARCH (1,1) process describing the inflation rate. It is assigned to each contract according to the effective date.

Realuncert: Real uncertainty generated as the one quarter ahead forecast of the conditional variance from a GARCH (1,1) process describing the deviation of real GDP (Statistics Canada D15721, billions of 1992 dollars) from an estimated linear trend. It is assigned to each contract according to the effective date.

In the case of the recursive GARCH, the procedures used to generate the three variables are the same except that the underlying framework is reestimated for every quarter in the sample, maintaining a constant sample size as we move forward.

Survey data:

The Conference Board in Canada provided their record of surveys of professionals in the financial sector on future inflation and real GDP growth. The mean value of the responses constitutes the expected inflation (SOF-Expinf) and the variance of their responses the uncertainty variable - nominal (SOF-Nomuncert) or real (SOF-Realuncert) for the inflation rate and real GDP growth respectively. The responses are at the earliest available point in the year.

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Table 1

Summary Statistics[a]

Variable	Description	Mean	Std Dev
Duration	contract length in months	25.629	11.499
Cola	dummy variable: contract contains COLA	0.192	0.394
Elasticity	elasticity of indexation	0.075	0.257
E| E>0	conditional elasticity of indexation	0.579	0.462
Pcola	dummy variable: previous contract contains COLA	0.206	0.404
Pelasticity	the intensity of indexation for previous contract	0.085	0.269
Pdur	contract duration (previous contract)	23.892	9.906
Pnomwage	nominal wage (previous contract)	13.308	5.470
Prealwage	real wage (previous contract)	0.157	0.048
Natres	dummy variable: natural resources	0.027	0.163
Manuf	dummy variable: manufacturing[b]	0.195	0.396
Constr	dummy variable: construction	0.051	0.220
Transp	dummy variable: transportation	0.082	0.274
Commun	dummy variable: communications	0.036	0.186
Utils	dummy variable: utilities	0.028	0.165
Trade	dummy variable: trade	0.042	0.200
Educat	dummy variable: education	0.251	0.434
Health	dummy variable: health care	0.085	0.278
Service	dummy variable: services	0.032	0.176
Others	dummy variable: other sectors	0.171	0.377
Atlantic	dummy variable: Atlantic region	0.071	0.257
Que	dummy variable: Quebec	0.150	0.358
Ont	dummy variable: Ontario[b]	0.365	0.481
Prarie	dummy variable: Prarie provinces	0.170	0.376
BC	dummy variabe: British Columbia	0.115	0.319
Terri	dummy variable: Territories	0.005	0.069
Mprov	dummy variable: muti-province contracts	0.124	0.330
Employee	number of employees covered by contract	2138.250	4644.470
Lemployee	natural logarithm of employee	7.073	0.902
Rurate	quarterly regional unemployment rate	9.361	2.762
Expinf	expected inflation estimated from GARCH	4.446	3.053
Nomuncert	nominal uncertainty from GARCH	0.296	0.119
Realuncert	real uncertainty (linear filter) from GARCH	12.918	4.634
Sof-expinf	expected inflation estimated from SOF	4.985	2.992
Sof-nomuncert	inflation uncertainty estimated from SOF	0.436	0.167
Sof-realuncert	real uncertainty estimated from SOF	0.534	0.221

[a] Based on 9646 observations for which previous contract information is available. They are drawn from 1977 - 2000. The original sample consists of 11885 contracts drawn from 1976-2000.The SOF variables are derived from the Conference Board of Canada Survey of Professional Focasters (SOF).

[b] This category constitutes the omitted class.

Table 2
Estimation Results for Contract Duration

Method	Reduced Form		Amemiya	
Variable	**Coefficient**	**Coeff/S.E.**	**Coefficient**	**Coeff/S.E.**
Intercept	30.625	29.100	33.505	21.112
Elasticity			1.996	5.965
Pdur	0.333	29.960	0.315	22.379
Prealwage	0.016	0.590	-0.010	-0.238
Pelasticity	2.524	6.500		
Natres	-0.507	-0.810	-0.462	-0.564
Constr	-2.899	-4.870	-1.803	-2.071
Transp	-1.194	-2.680	-0.876	-1.367
Commun	-2.679	-4.520	-2.301	-2.819
Utils	-3.715	-5.930	-3.203	-3.853
Trade	-0.894	-1.690	0.190	0.229
Educat	-6.990	-21.600	-6.104	-12.830
Health	-4.304	-10.230	-3.431	-5.396
Service	-2.196	-3.650	-1.116	-1.162
Others	-4.800	-13.650	-3.874	-7.186
Atlantic	5.601	10.760	5.451	7.269
Que	4.269	11.750	3.801	7.327
Prairie	0.811	2.770	0.884	2.005
BC	2.914	8.270	3.231	6.047
Terri	1.575	1.120	1.262	0.715
Mprov	1.192	3.110	1.570	2.486
Lemployee	0.045	0.400	-0.102	-0.639
Rurate	-0.340	-6.250	-0.252	-3.113
Expinf	-0.967	-25.710	-1.076	-18.561
Nomuncert	-5.093	-5.680	-5.165	-4.014
Realuncert	-0.198	-9.000	-0.171	-5.330
$Sigma^2$	88.219		87.811	
R^2	0.335		0.335	
Nobs	9646		9646	

Table 3
Estimation Results for Elasticity of Indexation

Method	**Reduced Form**		**Amemiya**	
Variable	**Coefficient**	**Coeff/S.E.**	**Coefficient**	**Coeff/S.E.**
Intercept	-1.443	-9.090	-2.293	-9.444
Duration			0.028	5.996
Pdur	0.009	6.310		
Prealwage	0.013	2.850	0.012	2.633
Pelasticity	1.265	48.150	1.195	35.248
Natres	-0.023	-0.280	-0.009	-0.098
Constr	-0.549	-6.070	-0.469	-4.879
Transp	-0.160	-2.270	-0.127	-1.699
Commun	-0.189	-2.210	-0.115	-1.233
Utils	-0.256	-3.130	-0.153	-1.694
Trade	-0.543	-5.890	-0.518	-5.387
Educat	-0.444	-9.860	-0.250	-3.884
Health	-0.437	-6.410	-0.318	-4.154
Service	-0.541	-4.850	-0.480	-4.115
Others	-0.464	-8.410	-0.331	-5.025
Atlantic	0.075	0.890	-0.081	-0.854
Que	0.235	4.010	0.116	1.757
Prairie	-0.036	-0.700	-0.059	-1.102
BC	-0.159	-2.610	-0.240	-3.679
Terri	0.157	0.950	0.113	0.633
Mprov	-0.189	-2.460	-0.223	-2.786
Lemployee	0.074	4.420	0.073	4.114
Rurate	-0.044	-4.760	-0.035	-3.537
Expinf	0.055	8.900	0.082	9.657
Nomuncert	0.036	0.250	0.177	1.157
Realuncert	-0.014	-3.740	-0.008	-2.110
$Sigma^2$	0.5613	71.42	0.0469	
Log likelihood	-2954			
R^2	0.2381		0.2274	
Nobs	9646		9646	
Censored Nobs	8390		8390	

Table 4
Decompostion of Amemiya Results for Elasticity

Variable	Coefficient	Marginal Effect	Intensity Effect	Incidence Effect	Elasticity Effect	Probability Effect
Intercept	-2.293	-0.193	-0.031	-0.162	-0.367	-0.472
Duration	0.028	0.002	0.000	0.002	0.005	0.006
Prealwage	0.012	0.001	0.000	0.001	0.002	0.003
Pelasticity	1.195	0.100	0.016	0.084	0.191	0.246
Natres	-0.009	-0.001	0.000	-0.001	-0.001	-0.002
Constr	-0.469	-0.039	-0.006	-0.033	-0.075	-0.097
Transp	-0.127	-0.011	-0.002	-0.009	-0.020	-0.026
Commun	-0.115	-0.010	-0.002	-0.008	-0.018	-0.024
Utils	-0.153	-0.013	-0.002	-0.011	-0.025	-0.032
Trade	-0.518	-0.044	-0.007	-0.037	-0.083	-0.107
Educat	-0.250	-0.021	-0.003	-0.018	-0.040	-0.052
Health	-0.318	-0.027	-0.004	-0.022	-0.051	-0.066
Service	-0.480	-0.040	-0.007	-0.034	-0.077	-0.099
Others	-0.331	-0.028	-0.005	-0.023	-0.053	-0.068
Atlantic	-0.081	-0.007	-0.001	-0.006	-0.013	-0.017
Que	0.116	0.010	0.002	0.008	0.019	0.024
Prairie	-0.059	-0.005	-0.001	-0.004	-0.009	-0.012
BC	-0.240	-0.020	-0.003	-0.017	-0.038	-0.049
Terri	0.113	0.010	0.002	0.008	0.018	0.023
Mprov	-0.223	-0.019	-0.003	-0.016	-0.036	-0.046
Lemployee	0.073	0.006	0.001	0.005	0.012	0.015
Rurate	-0.035	-0.003	-0.001	-0.003	-0.006	-0.007
Expinf	0.082	0.007	0.001	0.006	0.013	0.017
Nomuncert	0.177	0.015	0.002	0.013	0.028	0.037
Realuncert	-0.008	-0.001	0.000	-0.001	-0.001	-0.002
F(z)[a]	0.084					
f(z) [b]	0.154					
E(Elasticity) [c]	0.029					
E(Elasticity)*	0.343					

[a] F is the cumulative standard normal density function evaluated at z, where $z = \bar{x}\hat{\beta} / \hat{\sigma}$
[b] f is the standard normal probability density function.
[c] Mean value of estimated unconditional elasticity, where E(Elasticity*) denotes the mean value of the conditional variable - see section 4.1.

Figure 1

Annual Duration (months, right scale), Elasticity and Cola (left scale): 1977-2000

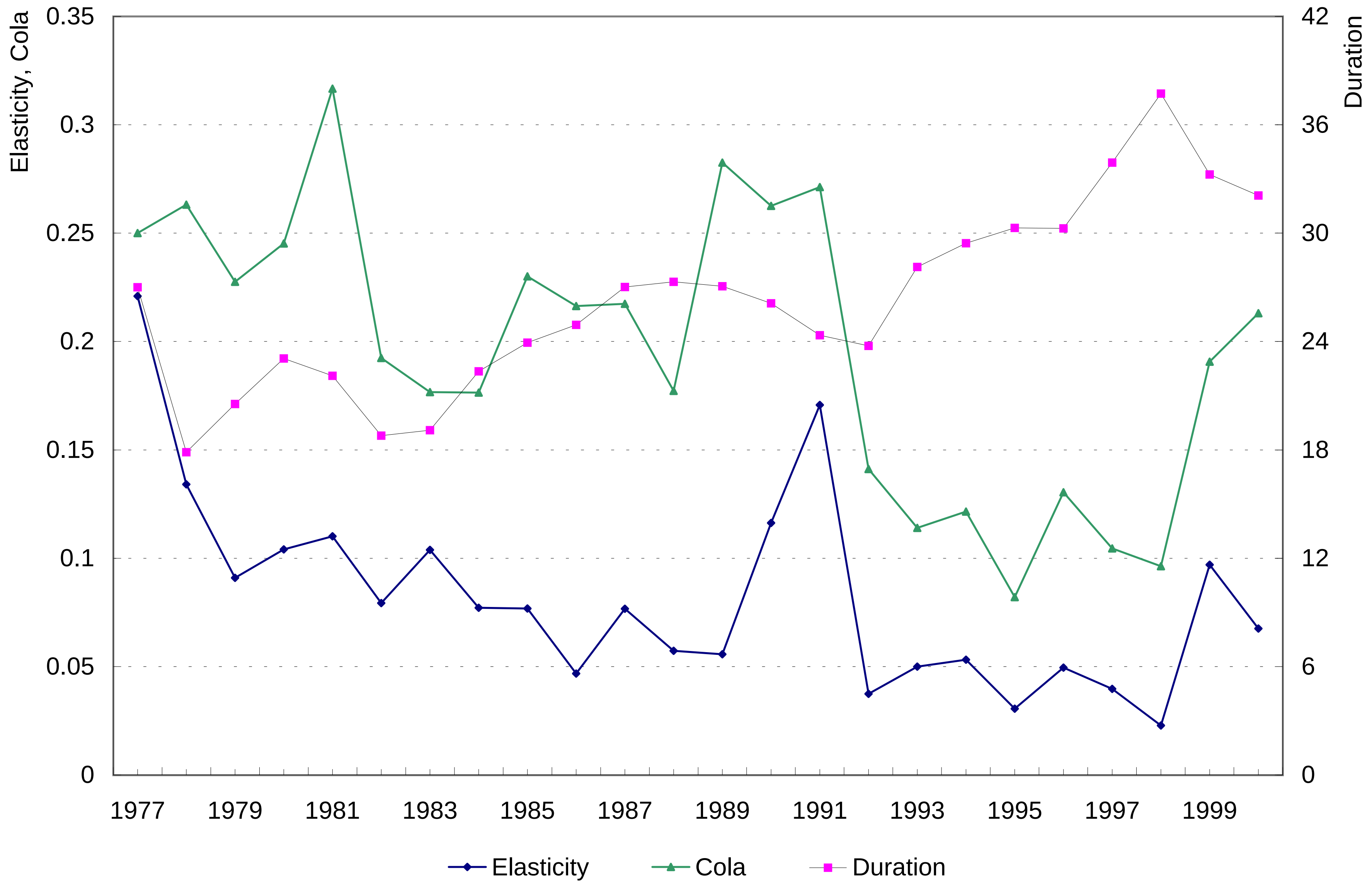

Figure 2
Actual and Expected Inflation in Percent

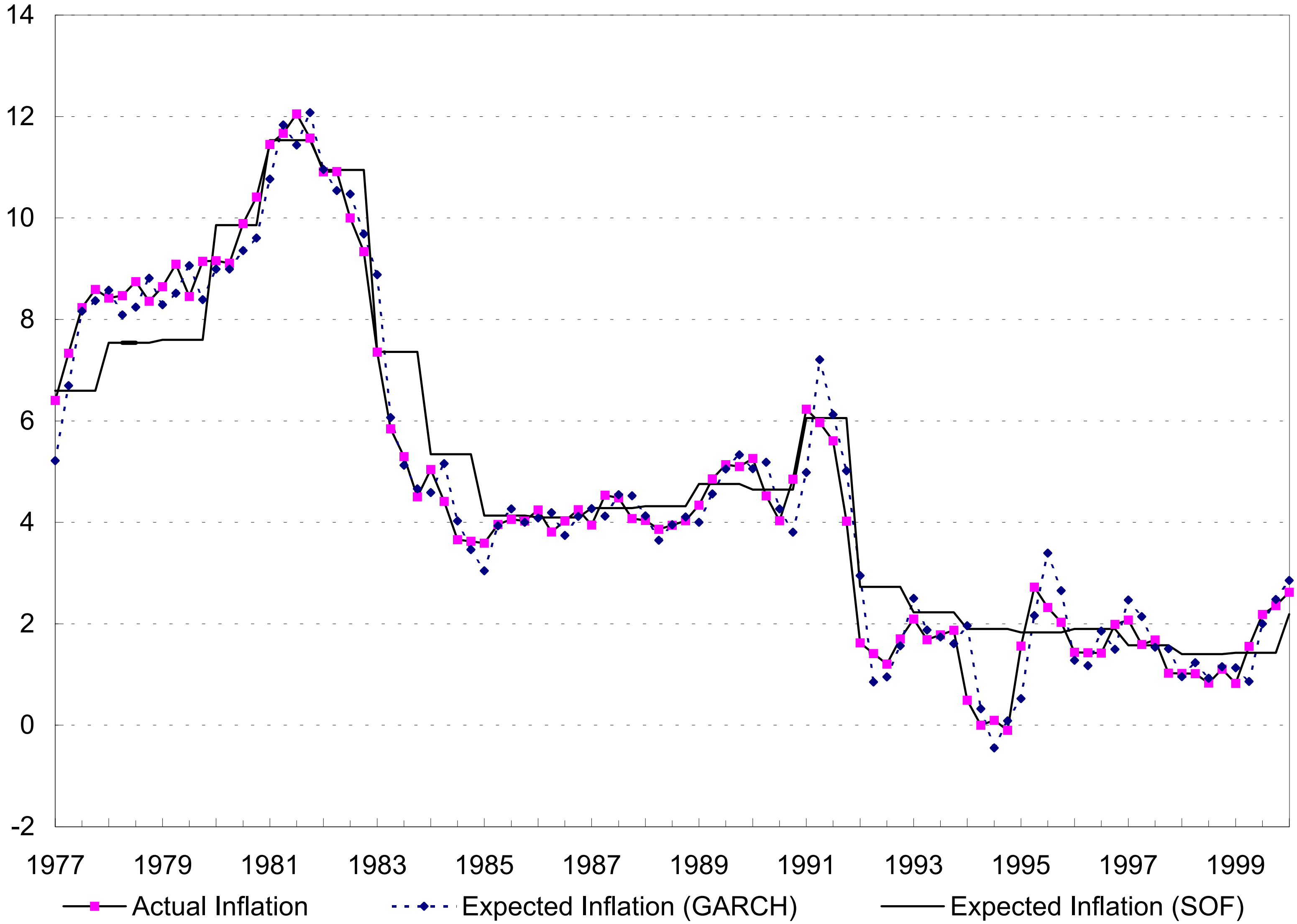

Figure 3

Actual and Predicted Deviation of Real GDP From Linear Trend (GARCH Estimation)

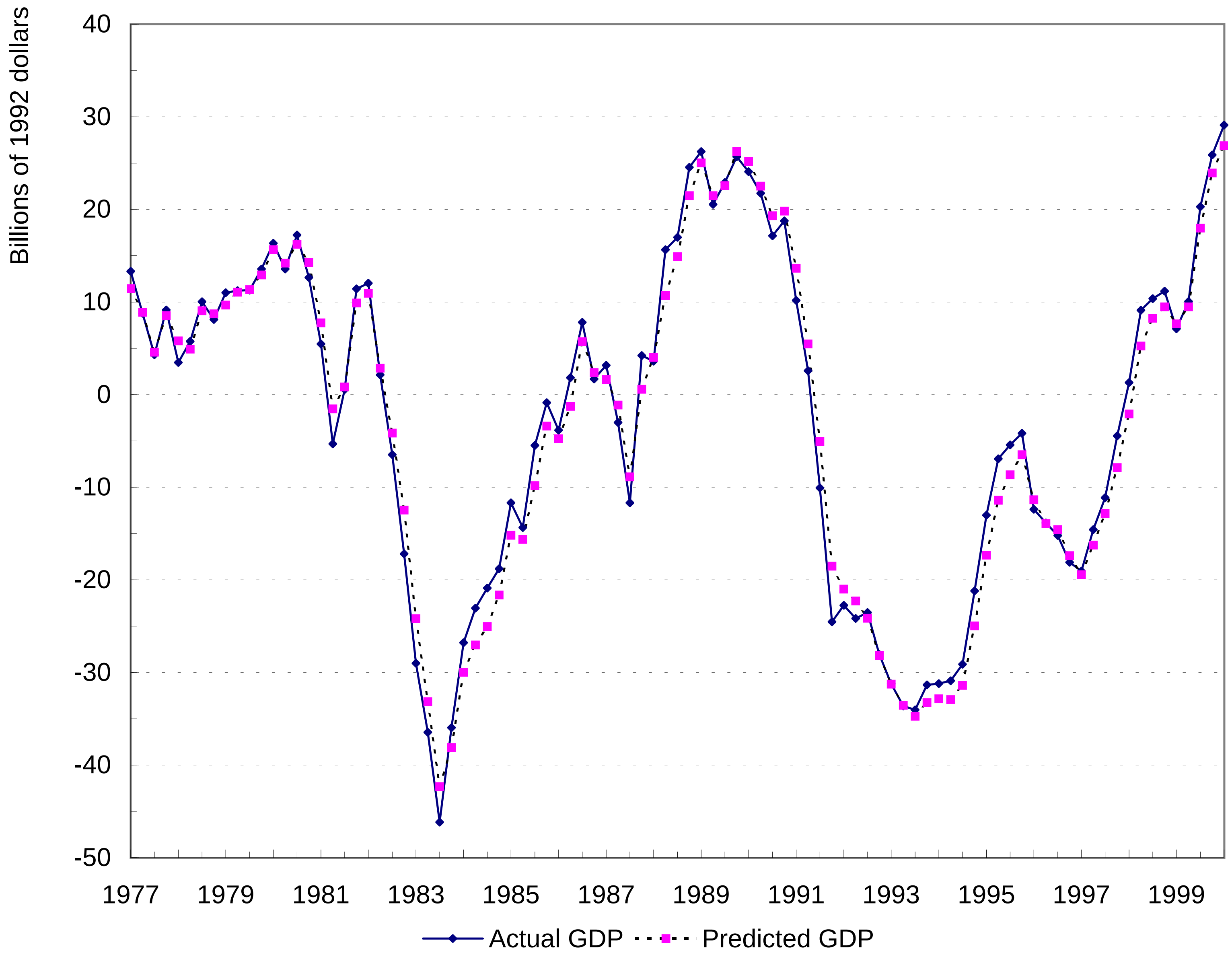

Figure 4
GARCH Estimation of Nominal Uncertainty and Real Uncertainty

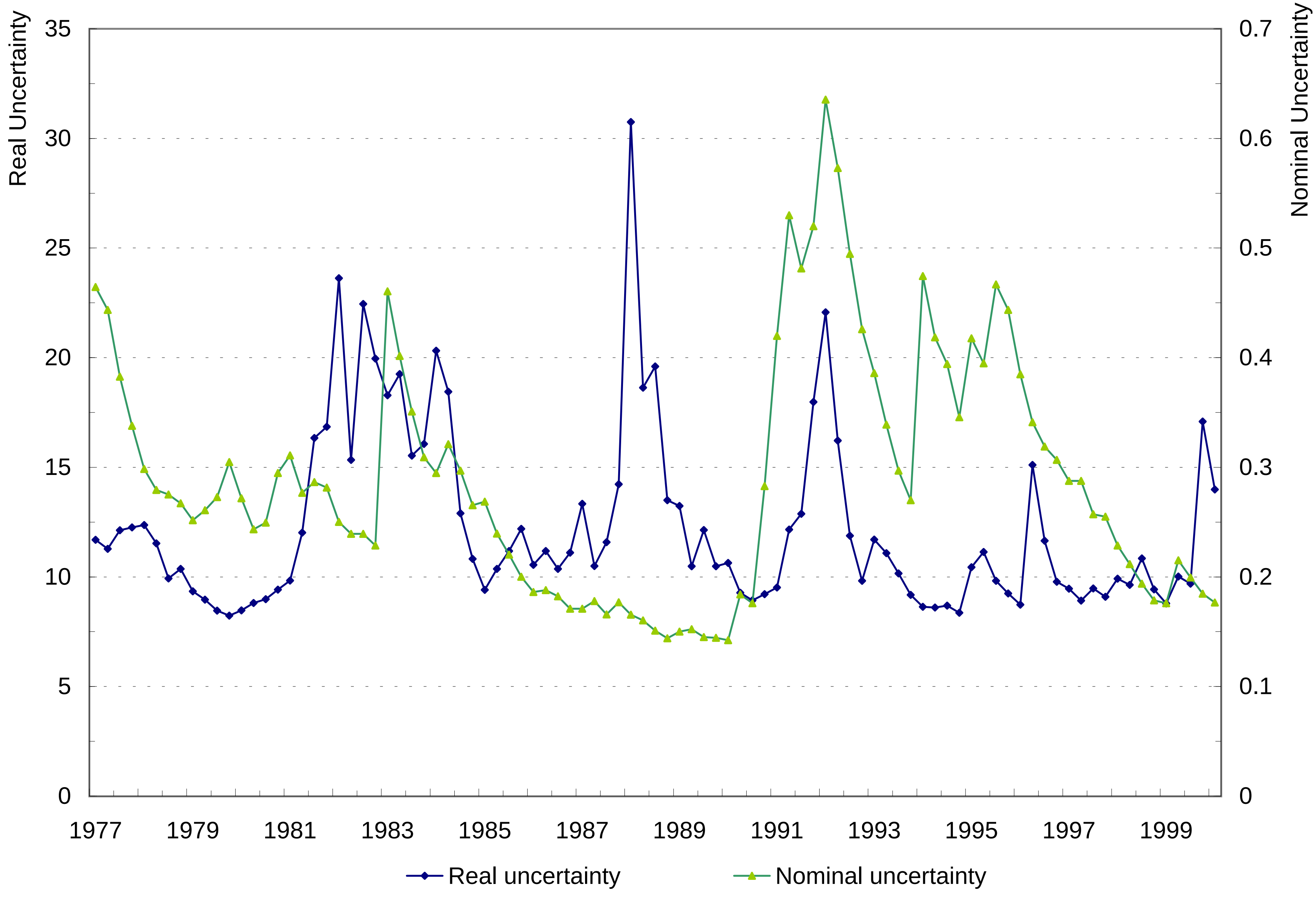

Figure 5

Actual and Reduced Form Estimation of Contract Duration

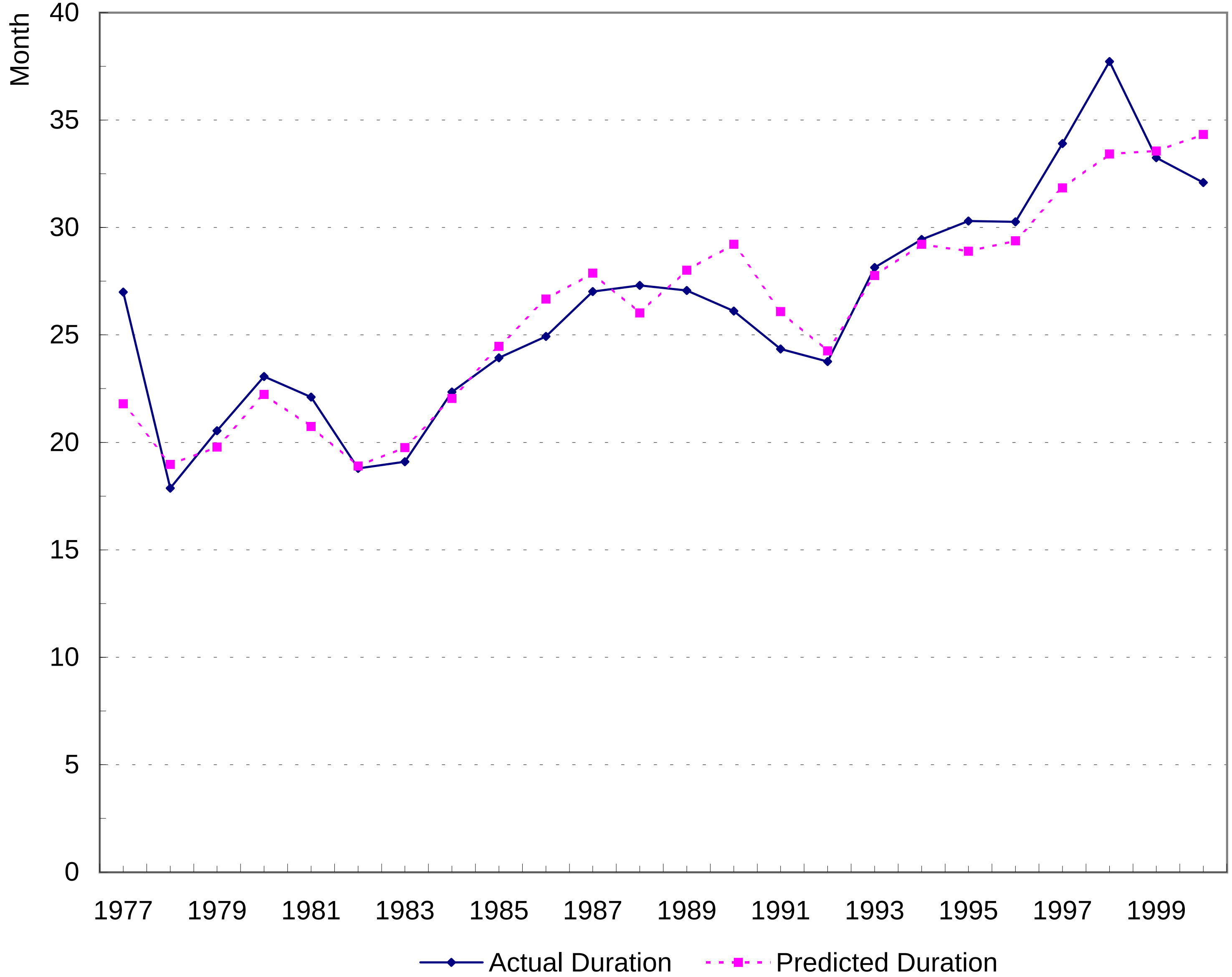

Figure 6

Actual and Reduced Form Estimation of Elasticity

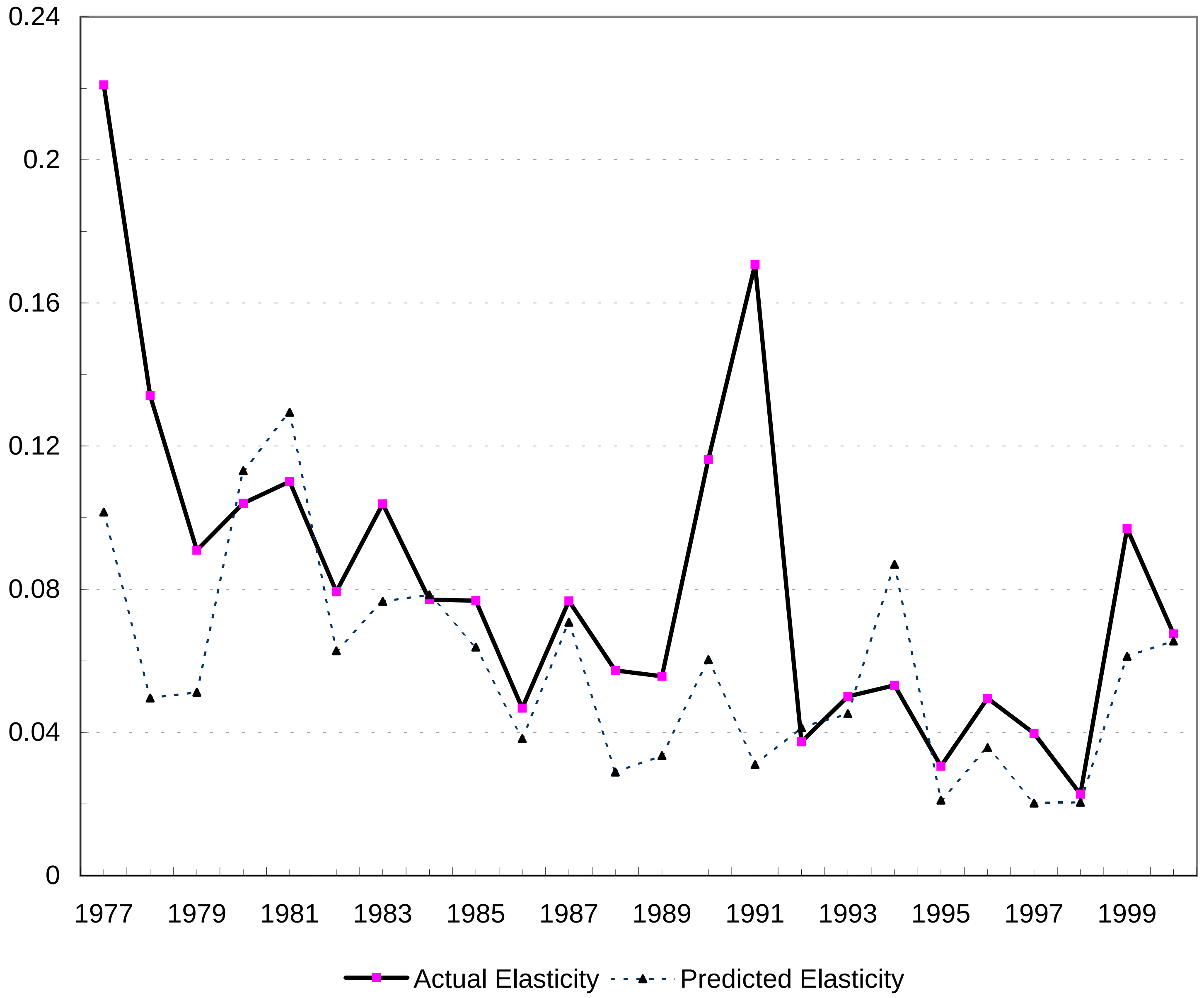

Figure 7

Contracts for which Elasticity is Positive (E>0) and Reduced Form Probability of Indexation (F(z))