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PROPAGATION OF INFLATIONARY SHOCKS IN CHILE AND AN INTERNATIONAL COMPARISON OF PROPAGATION OF SHOCKS TO FOOD AND ENERGY PRICES

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Abstract

When a specific price is affected by a shock, this may spread to other prices and thus affect the overall inflation rate by more than the initial effect. This phenomenon is known as propagation of inflationary shocks and is the subject investigated in the present paper. It is argued that structural VAR models, with an imposed Cholesky decomposition, are suitable for the propagation analysis when the data vector includes the component affected by the initial shock and the rest of the CPI basket. The empirical analysis with annual Chilean inflation rates suggests that the propagation effects have generally diminished after the implementation of the inflation-targeting regime in September 1999. Propagation of shocks to the division including food prices, however, has increased, albeit with a delay of four months. An analysis of propagation of energy and food price shocks in seven industrialized and four Latin-American countries suggests that the effects in Chile are amongst the largest and, in the case of energy price shocks, with the longest duration.

Resumen

Cuando un precio particular es afectado por un *shock*, dicho *shock* puede extenderse a otros precios y de este modo afectar a la tasa de inflación total más de lo que es el efecto inicial. Este fenómeno se conoce como propagación de *shocks* inflacionarios y es el tema del presente estudio. Se argumenta que modelos VAR estructurales, con una descomposición Cholesky impuesta, son adecuados para el análisis de propagación cuando el vector de datos contiene el componente afectado por el *shock* inicial y el resto de la canasta IPC. El análisis empírico realizado con tasas anuales de inflación de Chile, indica que los efectos de propagación en general han disminuido después de la implementación del régimen de meta de inflación en septiembre de 1999. No obstante, la propagación de los *shocks* a la división que incluye precios de alimentos ha aumentado, aunque con un rezago de cuatro meses. Un análisis de la propagación de *shocks* a precios de energía y alimentos en siete países industrializados y cuatro de la región latinoamericana sugiere que los efectos en Chile están entre los más grandes y, en el caso de los *shocks* a precios de energía, con la duración más larga.

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1. Introduction

Whenever a shock hits a specific price, it may spread to other prices and thus affect the overall inflation rate by more than the initial effect. This phenomenon is referred to as propagation of inflationary shocks. A general analysis of the propagation mechanism improves the understanding of how individual price changes influence the overall consumer price index (CPI) inflation, which is the relevant measure for several inflation targeting central banks, such as the Central Bank of Chile. Different from investigations on pass-through effects, where the focus is on external shocks (e.g. oil prices or exchange rates), an analysis of propagation is concerned with shocks to components included in the consumer price basket.

It is argued in the present analysis that structural VAR models are useful for studying propagation of inflationary shocks when the data vector includes the complete CPI basket. The shocks are identified by imposing a Cholesky decomposition such that the shock to a specific price has a contemporaneous effect on the rest of the prices in the basket, whereas the opposite is not the case. In the present context, these models are referred to as propagation models.

In the first analysis, Chilean price data are utilized for impulse response analyses of a period prior to the implementation of the inflation target and another containing data from the subsequent period. The results suggest that, in general, the effect of propagation has diminished after the implementation of the inflation target. More specifically, the main results suggest that shocks to prices of five of the twelve divisions of the CPI basket propagate significantly to the other prices before and after the adoption of the inflation target. In most cases, however, the propagation effects are smaller after the change of the monetary anchor and the durations are shorter. Shocks to another two divisions propagated positively in the early subsample, but the effects are not significant in the late one. On the other hand, shocks to one division propagate (negatively) to other prices only after introducing the inflation target. Finally, shocks to four divisions propagate significantly in neither of the subsamples. These results suggest that, in general terms, the implementation of inflation targeting in Chile has reduced the effects of propagation of inflationary shocks.

The second analysis compares the effect of shocks to energy and food prices in Chile and a number of industrialized and Latin-American countries. Inflation data from 1999 to 2009 are utilized in three-dimensional VAR models, where shocks in energy prices contemporaneously affect food prices and the rest of the prices, while food price shocks have immediate effect on the rest of the basket. The results from this analysis indicates that the propagation of food price shocks to core inflation in Chile is amongst the highest, while the duration is longer in several other countries. With respect to energy price shocks, the effect of propagation to core inflation in Chile is amongst the largest and with the longest duration.

Few papers are concerned with the propagation of domestic price shocks. The topic has, however, been briefly discussed in the papers of Levin et al. (2004) and Kim and Park (2006), where the inflation volatility, estimated in a univariate autoregressive (AR) model is decomposed into two sources, one due to the variance of the shocks and one due to the propagation of the shocks. Pedersen (2008)[1] made a similar exercise for Chile. He finds that the volatility of underlying measures of inflation is in line with those reported for more developed countries, while the propagation effect is larger in Chile. In the present paper, propagation is treated somewhat differently as the objective is to analyze how a shock to a particular price group affects the rest of the prices in the consumer price basket.

Even though there are few papers concerned directly with propagation of price changes, several studies are dedicated to the related issues of inflation persistence and pass-through of shocks to specific prices. With respect to inflation persistence, Angeloni et al. (2004) report the results of the so-called inflation persistence network; a project carried out by the European Central Bank and twelve national central banks of the eurosystem. Naïve estimates on inflation persistence[2] in the euro area span between 0.74 and 1.04 depending

[1] Mimeo used as background study for a box included in Central Bank of Chile (2008).

[2] Measured as suggested by Andrews and Chen (1994).

on the sample used and the price measure. For the U.S., the estimates range from 0.65 to 1.03. When allowing for time-variations in the mean, the persistence falls a great deal. Euro area estimates for components of the CPI basket indicate that "Miscellaneous goods and services", "Furnishings, household equipment and routine household maintenance" and "Education" are the most persistent categories, while "Transportation", "Alcoholic beverages, tobacco and narcotics" and "Recreation and culture" are the least persistent.

Concerning the Chilean economy, studies related to inflation persistence include Agénor and Bayraktar (2003), Céspedes and Soto (2006), De Gregorio (2007) and, more recently, Pedersen (2008) and Pincheira (2009). The first two estimate neoclassical Phillips curves and they find that, with the specifications applied, the coefficient of the lagged inflation rate is 0.52 and 0.45, respectively. Estimating an AR(1) process for the difference between the inflation rate and the target of the central bank, De Gregorio (2007) finds that the coefficient for the first lag is 0.82. Pincheira (2009) evaluates the dynamic of the inflation persistence estimating AR models for different periods. He finds that the persistence of the Chilean inflation increased importantly in the middle of 2007 but tended to decrease again toward the last part of the sample, which ends in 2008. The increasing persistence is in line with the evidence found by Pedersen (2008).

There exists a huge amount of literature on pass-through of international price changes to national inflation rates. In the case of Chile, mainly three types of pass-through have been investigated: exchange rate variations, oil price changes and changes in international food prices. Fuentes (2007) has studied the pass-through of nominal exchange rate movements to import prices for four developing countries (Argentina, Chile, Colombia and Uruguay). He estimates several models and finds that the pass-through is fast in the short-run and complete within one year. In contrast with similar studies, for example that of Frankel et al. (2005), he finds no evidence that exchange rate pass-through has declined over time. García and Restrepo (2003) apply quarterly Chilean data to estimate a price equation based on a model with imperfect competition. They find that devaluation has real effects but they vanish in the long run. When wage indexation is incomplete, the long-run pass-through is much smaller. Finally, a negative output cap compensates the effect of the devaluation on inflation such that a part of this is not passed on to prices in the short run. The paper of Álvarez, Jaramillo and Selaive (2008) studies the exchange rate pass-through into 40 disaggregated import prices using monthly data. The authors find evidence consistent with the idea that the pass-through is complete in the long run and that it has not been declining. Furthermore, they report relatively weak evidence of asymmetric pass-through for aggregate import indexes, while there seems to be some evidence of asymmetries for capital goods and agriculture. Utilizing a micro approach, Álvarez, Leyva and Selaive (2008) examine the pass-through of exchange rate changes to components and subcomponents of the CPI. Their model is estimated with monthly data from February 1998 to April 2007. Evidence from this study suggests that only food and transportation prices are significantly affected by the pass-through, but with a high degree of heterogeneity among the products.

De Gregorio et al. (2007) augment the traditional Phillips curve to include oil prices and structural breaks for a set of 34 countries, industrialized and emerging. They find clear evidence of decreasing pass-though in industrial economies and to a lesser degree for emerging ones. The difference in the pass-though, however, is smaller when controlling for the countries' oil intensity. The authors also estimate rolling vector autoregressive (VAR) models for a subsample of 12 countries, including Chile. Impulse-response analyses indicate that the effect of oil price shocks on inflation has fallen for most of these economies. Pincheira and García (2007) estimate several VAR and Panel VAR (PVAR) models with data from Chile and a set of nine industrialized countries. Their impulse-response analyses are conducted in models estimated with headline inflation as well as measures excluding particular components. They find that the pass-though in Chile is less than what is supposed in other studies, for example those of Medina and Soto (2005) and Magendzo and Núñez (2006), but the responses are in general significantly higher that the average response of the industrialized countries considered in the study.

With respect to the pass-through of international food prices, López et al. (2008) analyze the effects on the Chilean inflation of prices changes in wheat and corn. They find that the half-life of a shock in the international wheat price is 5.2 months and for corn, it is 7.1

months. These estimates increase significantly when applying models that do not include fundamentals, such as the AR(1) model. A permanent 10% shock in the international prices of wheat and corn has an impact of 0.06 percentage point in the monthly CPI, 0.07 in the CPIX and 0.09 in the CPIX1.[3]

While the papers cited above in general do not directly deal with the issue of propagation of inflationary shocks, they are certainly related. Pass-trough studies, however, are concerned with the general effect of external price shocks whereas propagation is defined here as the impact that the price of one component of the CPI basket has on the rest of the prices, which, among other things, depends on the persistence of both the component and the rest of the prices. This implies that the pass-through of, say, oil price shocks, has a mechanism, which can be exploited in greater detail by the so-called propagation models which will be utilized in this work.

The rest of the paper is organized as follows: The next section proposes a definition of propagation and introduces an empirical model for analyzing propagation of inflationary shocks. The third section supplies a discussion of the data utilized and the empirical analysis of propagation in Chile. Section four offers the analysis of energy and food price shocks, while the last section supplies the conclusions.

2. Methodology and measurement of propagation

The propagation mechanism employed in the present analysis is illustrated in figure 1. The inflationary shock to component *i* may have a direct effect on the rest of the prices in the CPI basket. As an example, consider an oil-price shock, which, via the pass-through mechanism, affects the energy prices, say component *i* of the basket. The increased energy prices affect production costs, such that the prices of the final goods increase. This mechanism is referred to as the direct effect in figure 1. On the other hand, increased energy prices may also have an impact on the household budget such that the general

[3] CPIX excludes fuels and fresh fruit and vegetables from the CPI, while CPIX1 also excludes fresh meat and fish, regulated utility rates, indexed prices and financial services.

demand will decrease putting a downward pressure on goods prices. This mechanism is named the indirect effect in figure 1. The arrow from the inflation of the rest of the basket (π^{-i}) to the inflation of component *i* (π^{i}) indicates a possible feed-back mechanism, which could be caused, for example, by a cost-push effect. The total propagation effect is the total effect on π^{-i} of a shock to π^{i} accounting also for the persistence of each of the two components.

[Figure 1]

As illustrated in figure 1, in the discussion of propagation is important to make the distinction from persistence. In the present context, we define persistence as the duration of a shock on the same component that was affected by the shock. On the other hand, propagation is understood as the effect on components other than the one affected by the initial shock. Formally, we use the following definitions:

> ***Definition 1*: Persistence of inflationary shocks:** The impact a shock to price *i* at time *t* has on the same price *i* at time *t*+*h* (*h*=1,2,3,…).

> ***Definition 2*: Propagation of inflationary shocks:** The impact a shock to price *i* at time *t* has on other prices *j* ($j \neq i$) at time *t*+*h* (*h*=0,1,2,3,…).

As mentioned in the introduction, the literature of inflation dynamics contains several references to propagation but without discussions of definition and measurement. Levin et al. (2004), however, have given one suggestion, and this will be outlined in the next subsection. The subsequent subsection 2.2 suggests another way of measuring propagation, in line with definition 2, which will be applied in the empirical analysis in section 3.

2.1. Persistence and propagation in Levin et al. (2004)

Levin et al. (2004) suggest measuring inflation persistence by estimating a univariate process for inflation:

$$\pi_t = \mu + \sum_{j=1}^{K} \alpha_j \pi_{t-j} + \varepsilon_t, \tag{1}$$

where ε_t is a serially uncorrelated homoskedastic random error term. Two measures of inflation persistence are used in this study: the largest root of the characteristic equation:

$$\lambda^K - \sum_{j=1}^{K} \alpha_j \lambda^{K-j} = 0, \tag{2}$$

and the sum of the autoregressive coefficients in (1):

$$\alpha = \sum_{j=1}^{K} \alpha_j . \tag{3}$$

The intuition for the two measures of persistence is that the largest root of (2) determines the size of the large j of the impulse-response for a shock in ε_t, while (3) relates monotonically to the cumulative impulse-response of π_{t+j} to ε_t.[4]

Levin et al. argue that inflation volatility according to (1) can be decomposed into two sources: the variance of the shocks to the auto regression and the propagation of the shock through the dynamic of the regression. As a measure of this decomposition they calculate:

$$\xi = \frac{\mathrm{var}(\pi_t)}{\mathrm{var}(\varepsilon_t)}.$$

With this decomposition, the volatility of inflation due to propagation is:[5]

$$\mathrm{var}(\pi_t^{prop}) = \mathrm{var}(\pi_t) - \mathrm{var}(\varepsilon_t).$$

[4] See Andrews and Chen (1994).

[5] See Kim and Park (2006).

This formulation allows for an assessment of general inflation propagation, while an analysis of propagation of shocks, as defined in the present context, requires a different model specification, which is described in the next sub-section.

2.2. Propagation models

To focus the analysis on the propagation as defined earlier, the models include the two variables of interest: inflation of component *i* and the inflation rates of the remaining of the basket. Hence, the data vector can be summarized as:

$$x_t = \{\pi^{-i}, \pi^{i}\}, \qquad (4)$$

where π^i is the inflation rate of component *i* and π^{-i} is the rate of inflation of the total CPI minus the i'^{th} component. The data vector can include more components, as in the analysis presented in section 4, but the weighted sum of the items should always be the entire CPI basket. For simplicity, the discussion in the present section relates to the case with two variables.

It is assumed that $x_t \sim \text{I}(0)$ and that it can be described by a structural VAR (SVAR) with *p* lags. To simplify notation, in what follows it is assumed that $p = 1$ and constant terms are omitted:

$$\underbrace{\begin{bmatrix} 1 & \beta_{12} \\ \beta_{21} & 1 \end{bmatrix}}_{B} \underbrace{\begin{bmatrix} \pi_t^{-i} \\ \pi_t^{i} \end{bmatrix}}_{\pi_t} = \underbrace{\begin{bmatrix} \alpha_{11} & \alpha_{12} \\ \alpha_{21} & \alpha_{22} \end{bmatrix}}_{\alpha} \underbrace{\begin{bmatrix} \pi_{t-1}^{-i} \\ \pi_{t-1}^{i} \end{bmatrix}}_{\pi_{t-1}} + \underbrace{\begin{bmatrix} \varepsilon_{1t} \\ \varepsilon_{2t} \end{bmatrix}}_{\varepsilon_t}, \qquad (5)$$

where α's and β's refer to parameters to be estimated, $\varepsilon_{it} \sim i.i.d(0,\sigma_i^2)$ and $\text{cov}(\varepsilon_1,\varepsilon_2)=0$. With this notation, the unstructured VAR (UVAR) is obtained by pre-multiplying the system (5) by B^{-1} and, hence, the errors of the UVAR are

$$\underbrace{\begin{bmatrix} e_{1t} \\ e_{2t} \end{bmatrix}}_{e_t} = \underbrace{\frac{1}{(1-\beta_{12}\beta_{21})}\begin{bmatrix} 1 & -\beta_{12} \\ -\beta_{21} & 1 \end{bmatrix}}_{B^{-1}} \underbrace{\begin{bmatrix} \varepsilon_{1t} \\ \varepsilon_{2t} \end{bmatrix}}_{\varepsilon_t}.$$

In the interest of measuring the impact inflation of component i has on the rest of the CPI basket, it is assumed that π^i contemporaneously affects π^{-i} but not vice-versa, i.e. imposing the restriction $\beta_{21}=0$, which implies that the VAR becomes

$$\begin{bmatrix} \pi_t^{-i} \\ \pi_t^{i} \end{bmatrix} = \underbrace{\begin{bmatrix} \alpha_{11} - \beta_{12}\alpha_{21} & \alpha_{12} - \beta_{12}\alpha_{22} \\ \alpha_{21} & \alpha_{22} \end{bmatrix}}_{A=\begin{bmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{bmatrix}} \begin{bmatrix} \pi_{t-1}^{-i} \\ \pi_{t-1}^{i} \end{bmatrix} + \underbrace{\begin{bmatrix} \varepsilon_{1t} - \beta_{12}\varepsilon_{2t} \\ \varepsilon_{2t} \end{bmatrix}}_{v_t=\begin{bmatrix} v_{1t} \\ v_{2t} \end{bmatrix}}. \qquad (6)$$

From (6) it is evident that an inflationary shock in component i has a contemporaneous effect on the rest of the basket, whereas the opposite is not the case. This identification scheme makes the model suitable for analyzing the propagation of inflationary shocks where the object is exactly to evaluate the effect on the rest of the prices from a shock in a particular component.

The covariance of the error terms in (6) is

$$\text{cov}(v_{1t}, v_{2t}) = \text{cov}(\varepsilon_{1t} - \beta_{12}\varepsilon_{2t}, \varepsilon_{2t}) = E[\varepsilon_{1t}\varepsilon_{2t} - \beta_{12}\varepsilon_{2t}\varepsilon_{2t}] = -\beta_{12}\sigma_2^2,$$

such that the initial effect on π^{-i} of a unit shock in π^i is equal to the correlation of the residuals in the restricted VAR multiplied by the ratio of the standard deviations of the residuals:

$$\kappa = \left.\frac{\partial \pi_t^{-i}}{\partial \pi_t^{i}}\right|_{t=0} = corr(v_{1t}, v_{2t})\frac{\sigma_1}{\sigma_2}.$$

The propagation of a shock in component i relates to the total response in π^{-i}, but in VAR models the impulse-response coefficients are complex nonlinear functions of the underlying model parameters. In the empirical analysis, which follows, the coefficient κ is reported as the initial impact of the propagation mechanism, which is naturally influencing the total response.

3. Propagation of inflationary shocks in Chile

This section analyzes the propagation of inflationary shocks in Chile applying the propagation models described in the previous section. The focus is on how shocks in the divisions of the basket affect the rest of the prices. The following subsection contains a description of the data utilized, while subsection 3.2 presents the empirical analysis.

3.1. Description of data

The analysis is made with data covering the period from April 1989 to December 2009. The source of data for the CPI, which is constructed to cover the great Santiago area,[6] is Chile's National Statistics Institute (NSI). The series are spliced such that monthly inflation rates are maintained. A similar splicing is made for the divisions of the CPI only since January 1999;[7] hence, the source of the division data is Pedersen et al. (2009), who have spliced disaggregated inflation data since April 1989.[8]

As discussed in the previous section, the analysis of propagation is made applying impulse-response analyses in models of inflation rates. A natural question, the answer to which is not obvious, is at what frequency these rates should be calculated. One option is to use monthly or quarterly rates, in which case they will most surely be affected by seasonality. Corrections can be made by either using seasonally adjusted data or including seasonal dummies in the specification. With respect to the first possibility, Maravall (1993) argues that VAR models are not appropriate for modeling seasonal adjusted series, while Canova

[6] From January 2010 onwards, the index is compiled with national coverage.

[7] See National Statistics Institute (2009).

[8] Pedersen et al. (2009) show that in the overlapping period, there are only small differences between their division data and those published by the NSI.

(1995) adds that the empirical relevance of this has yet to be demonstrated. Lütkepohl (2005) notes that using seasonally adjusted data may lead to impulse-responses quite different from those with unadjusted data. In the present context of analyzing propagation of inflationary shocks, an impulse-response analysis with seasonally adjusted data may distort the interpretation of the results. This because procedures for seasonal adjustment, such as X12-ARIMA, apply two-sided moving averages in the filtering process implying that the seasonally adjusted observation for a given month implicitly incorporates information of previous and subsequent months, casting doubts about the interpretation of the error terms as unanticipated shocks.[9]

With respect to including seasonal dummies in the model, this relies on the assumption that the seasonal pattern is constant over time. In the period considered in this work, the NSI has twice updated the methodology, in 1998 and 2008, and, in particular, the last update entailed significant changes in the methodology for the compilation of some of the components.[10] For this reason, it is most unlikely that the seasonal patterns have been constant during the period considered in the present work, which is also confirmed by visual inspection of the CPI in figure 2. A pronounced example of the apparent change in seasonality is the October inflation rate, which in the first half of the sample was lower than the September rate only two years, while in the last part it was lower in eight of the ten years examined.

[Figure 2]

Given the preceding discussion it was chosen to apply annual inflation rates in the present study, in line with the choice of other authors; for example Pincheira and García (2007). This has also been the choice of studies conducted for other countries, such as that of Lindé (2003). With quarterly Swedish data, he estimates a VAR model and argues that it may be

[9] This argument has also been employed by Callen and Reynolds (1997).

[10] An example is wearing apparel. The compilation of this item included a smoothing parameter up until January 2008, where it was abandoned.

crucial for the empirical analysis to apply annual, rather than quarterly, inflation rates, and as long as inflation is positively autocorrelated, the effects of this choice are small.[11]

The present analysis is focused on the impact of a shock to one component on the rest of the prices in the basket. The inflation rates for the "rest", i.e. the complete basket excluding component *i*, is calculated as

$$\pi_t^{-i} = 100 * \left(\frac{P_t^{-i}}{P_{t-12}^{-i}} - 1 \right), \quad P_t^{-i} = \frac{P_t - w_{i,t} P_t^i}{1 - w_{i,t}},$$

where P is the aggregated price index, P^i is the price index for component *i*, P^{-i} is the aggregated index which excludes component *i*, while $w_{i,t}$ is the weight of component *i* in the CPI basket.[12]

As mentioned earlier, in the period analyzed, the base year has been changed on two occasions, January 1999 and January 2008. The fixed weights of the twelve divisions for the three base year periods are presented in table 1, where it can be appreciated that, for example, the weight of "Food and non-alcoholic beverages" has diminished over time, while those of e.g. "Recreation and culture" and "Education" have increased.

[Table 1]

Figure 3 presents the aggregate inflation rate, while figure 4 displays the rates of the twelve divisions. In the period analyzed, the Chilean inflation has decreased from an average of close to 12% in the first part of the period to around 3.5% in the last part. This decrease has been generalized across all divisions, but in particular, "Alcoholic beverages and tobacco", "Transport", "Communications" and "Miscellaneous goods and services" posted high inflation rates in the early 1990s.

[11] The Chilean inflation rates are indeed positively autocorrelated.

[12] Pedersen (2009) shows that Chilean inflation rates should be calculated with disaggregated indices, rather than inflation rates, in order to obtain the total CPI.

[Figure 3]

[Figure 4]

Descriptive statistics of the overall inflation rate and those of the divisions are reported in table 2 for the full sample and the two subsamples analyzed in the next section. While headline inflation in the period under consideration has oscillated between -1% and 30%, single divisions, such as “Communications” and “Miscellaneous goods and services”, have experienced greater volatility. In general, the inflation rate was higher and more volatile before the implementation of the inflation target policy in Chile, where all divisions except “Wearing apparel and footwear” showed two-digit average inflation rates.

[Table 2]

The methodology described in section 2 relies on the fact that the time series are stationary. Table 3 presents the augmented Dickey-Fuller test (ADF)[13] for the full sample, for the period prior to the implementation of inflation targeting in Chile (April 1990 – August 1999) and for the period after the change of the monetary policy (September 1999 – December 2009).[14] The tests were carried out for headline CPI, since this would be stationary only if the two variables in the VAR (π^i and π^{-i}) were both stationary, disregarding the unlikely case where both are integrated of order one and cointegrate with coefficients equal to their respective weights in the basket. Evidence from the tests suggests that the nulls of non-stationary series are rejected in all cases. Several studies (e.g. DeJong et. al (1992) and Agiakoglou and Newbold (1992)) have documented the low power of the ADF test and, hence, the rejections presented in the table point strongly towards the fact

[13] A description of the test can be found in, for example, Hamilton (1994).

[14] In September 1999, Chile moved to full adoption of inflation targeting with a flexible foreign exchange rate. In the present document this is referred to as the implementation of the inflation target, even though since 1990 the Central Bank of Chile has used a partial inflation targeting framework regime (see Central Bank of Chile, 2007).

that the Chilean inflation rate indeed has been stationary in the period considered in this study.[15] The assumption of stationary inflation rates in Chile has been employed by several other authors, e.g. Pincheira and García (2007).

[Table 3]

3.2. Empirical results

In this subsection, Chilean data are applied to evaluate propagation effects in the CPI. Chile is an interesting case for two reasons. Firstly, in 1999 the Central Bank adopted inflation targeting as the object of monetary policy, and hence, the Chilean data allow for evaluating the propagation of inflationary shocks before and after this regime. Secondly, in the last two years of the sample Chile has experienced inflation rates very distant from the target of 3%. Understanding better the effects of inflation propagation may help to explain these deviations.

The propagation analysis is made with data for the full sample (April 1990 to December 2009) as well as subsamples ending and starting, respectively, with the implementation of the inflation target as the monetary policy anchor. For this purpose, twelve VAR models are estimated for each of the samples under consideration. Since the dynamic properties of impulse-responses may depend critically on the chosen lag length (k), the same k is chosen for all the models, $k = 2$, in order to make the results comparable. As reported in table 4, the

[15] As is well known, the outcome of the ADF test may depend on the selected lag length and inclusion of deterministic terms. Robustness tests were carried out with models including between one and twelve lags, with and without a constant. With respect to the full sample and the early subsample, in all models, the constant term was not significantly different from zero and the null of non-stationarity was rejected in all models not including the constant term. In the late subsample, the hypothesis of a constant term equal to zero was rejected in the models including between three and eleven lags and in these cases the p-values for the null of non-stationarity were between 0.00 and 0.06. In the models not including a constant term, only in the case of five lags, the hypothesis of non-stationarity was rejected. The stationarity assumption, however, was also validated when testing this null applying the test developed by Kwiatkowski et al. (1992).

Schwarz information criterion suggests in most models to include between one and three lags, while Akaike and Hannan-Quinn suggest including more lags.

[Table 4]

Table 5 reports the main results of the analysis of propagation of inflationary shocks in the twelve divisions of the Chilean CPI, while the graphs of the responses are included in appendix A. The first thing to note is that shocks to four of the twelve divisions do not propagate to the rest of the divisions of the baskets. These are "Alcoholic beverages and tobacco" (D2), "Wearing apparel and footwear" (D3), "Health" (D6) and "Recreation and culture" (D9), even though shocks to "Health" prices did have a significant contemporaneous impact on the other prices before September 1999. It is of interest, though not a surprise, that the recent highly negative inflation rate of D3 only affects itself and does not propagate to the other prices.

Another group consists of the prices whose shocks propagate to the rest of the prices either before or after the introduction of the inflation target, but not in both periods. These include "Furnishings, items for the household and for routine household maintenance" (D5), "Education" (D10) and "Miscellaneous goods and services" (D12). While shocks to D5 and D12 had significant and long lasting effects on the rest of the prices before 1999, they have not been propagating significantly after the implementation of inflation targeting. On the other hand, before the change of monetary anchor, shocks to the prices of "Education" had no significant impact on other prices, but after September 1999 shocks to this division propagate significantly and negatively between the fifth and the twentieth month after the initial shock, with the maximum effect after 16 months. Since the beginning of the sample analyzed, "Education" has almost doubled its weight in the basket, and it is possible that the negative propagation in the late subsample can be attributed to a demand effect, such that increasing education costs lower the demand of other articles resulting in reduced prices.

Shocks to the prices of four divisions propagate positively to the other prices in both subsamples. These are “Food and non-alcoholic beverages” (D1), “Housing, water, electricity, gas and other fuels” (D4), “Transport” (D7), and “Restaurants and hotels” (D11). The first three divisions are to some degree influenced by international food and oil prices and, hence, sensitive to international shocks. Furthermore, these are the items with the highest weights in the basket. The division D11, on the other hand, has a relatively small weight and before September 1999, the propagation was instantaneous and lasted more that two years, with the maximum effect after two months. In the latter period, however, propagation begins two months after the initial shock and lasts only five months, with the maximum effect in the second month after the shock.

Despite a decreasing weight for D1, propagation effects of price shocks to this division have increased, but after the inflation target implementation, propagation of these shocks occurs with a delay of four months. The prices of divisions D4 and D7 are partly affected by oil price changes. After 1999, the propagation of shocks to these prices has diminished in size as well as duration. While the duration of the propagation of inflationary shocks to D4, the division mostly related to oil prices, was 17 months in the early subsample, this diminished to eleven months in the late period. The maximum effect also decreased from 0.53 percentage points in month eight to 0.39 points after six months. With respect to “Transport” the maximum effect has more than halved and the duration is less than one third of what is was before the implementation of the inflation target.

A curious case is “Communications” (D8), where the propagation effect is significantly positive in the early sample and significantly negative in the late one. Even though the weight of this division is relatively low, it has more than doubled since the beginning of the sample analyzed and it is possible that the negative propagation in the second period can be attributed to a demand effect.

[Table 5]

The results from the empirical analysis of the propagation of inflationary shocks suggest that, in general, the implementation of an inflation target as the anchor of the monetary policy in Chile has resulted in a decreasing degree of propagation and, in a few cases, negative propagation effects of positive price shocks.

4. Propagation of shocks to energy and food prices

This section presents a comparative analysis of propagation of shocks to energy and food prices in Chile, a set of industrialized countries (USA, Canada, Japan, Germany, France, Spain and the UK) and some Latin-American economies (Brazil, Mexico, Colombia and Peru). Propagation of shocks to these prices are of particular interest since during the years 2007 – 2009 Chile was affected, not only by the international shocks to food and oil prices, but also to a number of idiosyncratic shocks due to climatically circumstances and restrictions on the importation of gas. Consequently, the Chilean inflation rate accelerated more that in other countries and fell faster when the international prices busted, which is illustrated in figure 5.

[Figure 5]

The propagation models applied for the analysis in this section include three variables, such that the data vector is written as

$$x_t = \left\{ \pi_t^{energy}, \pi_t^{food}, \pi_t^{core} \right\},$$

where "energy", "food" and "core" refer to annual inflation rates of the energy, food and less food and energy (core) components. The shocks are identified such that energy price shocks affect contemporaneously the food and core prices and food price shocks have instantaneously impact on core prices, whereas core price shocks have no impact on energy and food prices in period 0. Estimations are conducted with data covering the period 1999 – 2009 and the results are reported in tables 6 and 7. Graphs of the impulse-responses are included in appendix B.

[Table 6]

[Table 7]

First, it can be appreciated from the tables that during the price boom period, food prices increased more in Chile than in the other countries in the sample. With respect to the energy prices, only in the US these increased more than in Chile. On the other hand, in the bust periods there are several countries, where the prices fell more than in Chile, in particular the US energy prices decreased faster.

Secondly, the propagation effect of food price shocks is more persistent in Chile than in, for example, USA, Canada, Japan and Colombia, but less persistent than in Germany, France, the UK and Mexico. Amongst the countries in the sample, food price shocks in Chile have one of the largest impacts, comparable with those of Spain, Brazil and Mexico.

Finally, with respect to energy price shocks, in Chile the effect has longer duration than in most of the other countries, with Japan as the exception, and the impact on core inflation is among the biggest in line with those of Brazil, Colombia and Peru.

To sum up, compared with the countries analyzed in this section, Chile was amongst those with the highest inflation rates of the energy and food components in the boom periods, while several countries experiences lower rates in the bust periods. Propagation of food price shocks in Chile is large, compared to most of the other countries investigated and, in the case of energy prices; the propagation of these shocks to the core inflation is in Chile amongst the largest and with the longest duration.

5. Conclusion

The analysis in this paper is concerned with the propagation of inflationary shocks. So far, little research has been concerned with this important issue, while a lot of studies have focused on the related topics of inflation persistence and pass-through effects. It was argued that the propagation effects depend partly on the persistence of the component exposed to the initial shock and of that of the prices to which the shock propagates.

It was argued that structural VAR models with disaggregated data for the entire CPI basket are suitable for the analysis of propagation. The data vector in the national analysis consists of the component that is affected by the shock (i) and the rest of the CPI basket. The shocks are identified by a Cholesky decomposition such that the "rest" component is affected contemporaneously by a shock to component i, but not vice-versa.

The empirical analysis was conducted with annual Chilean inflation rates such that seasonal adjustment filters do not affect the results. In general, the results suggest that inflationary shocks propagate less after the implementation of the inflation-targeting regime in September 1999. As a main result, it was found that shocks to the three divisions with the highest weights in the CPI basket, divisions that are affected by international food and oil prices, are those having the highest degree of propagation to the other prices. However, while the propagation of shocks to the divisions partly affected by oil prices has diminished after the implementation of inflation targeting, shocks to food prices have a bigger propagation effect in the late subsample, although it occurs with a delay of four months. This suggests that for the control of the Chilean inflation rate is necessary to keep a close eye on food price shocks (national and international) such as those that occurred in Chile during the years 2007-2008.

In an international context, using data from seven industrialized countries and four Latin-American ones, it was argued that Chile was amongst the countries where energy and food prices increased most during the boom periods, while in several other countries they decreased more in the bust periods. With respect to energy price shocks, the propagation to core inflation where amongst the largest and with the longest duration.

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Appendix A

This appendix shows the responses of the rest of the prices of unit shocks to the divisions of the CPI basket. Punctuated lines indicate twice the standard deviations.

[Figure A1]

[Figure A2]

[Figure A3]

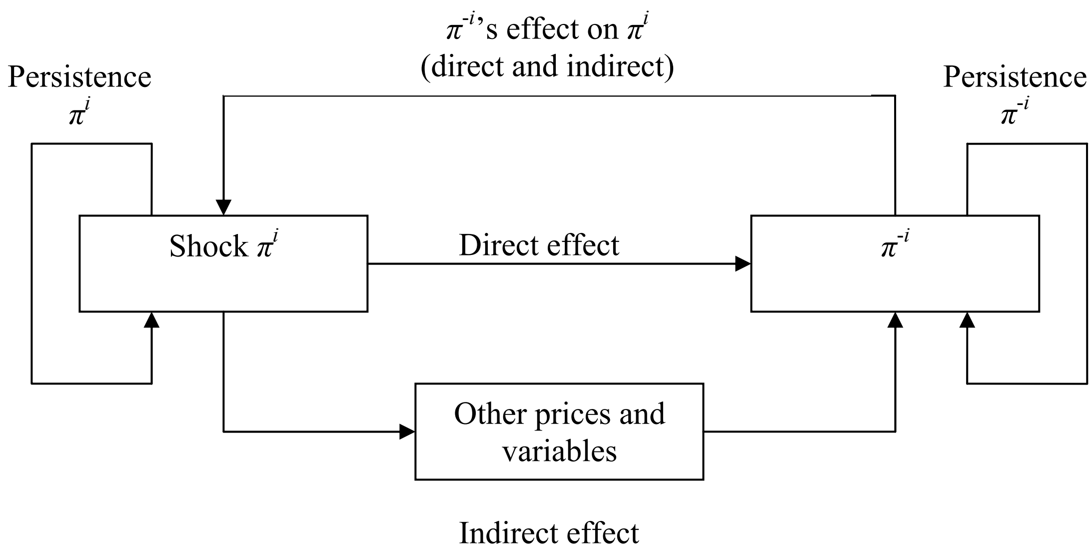
Appendix B

This appendix shows the responses of the core prices, i.e. CPI less food and energy, of unit shocks to energy and food prices. Punctuated lines indicate twice the standard deviations.

[Figure B1]

Figures and tables

Figure 1. The propagation mechanism

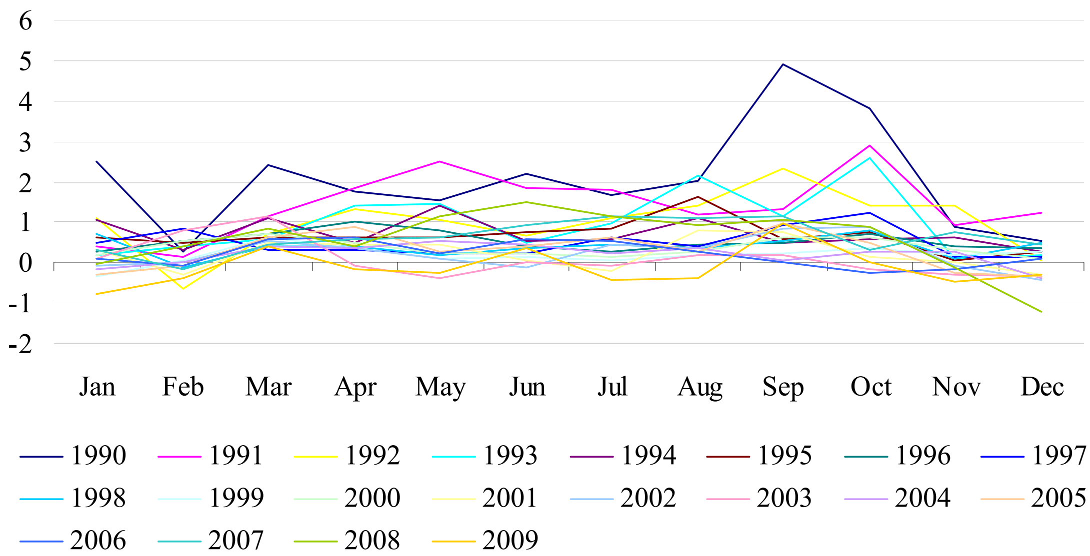


Source: Author's elaboration.

Note: π^i refers to the inflation of component *i*, while π^{-i} is the inflation of the CPI basket excluding component *i*.

Figure 2. Monthly CPI inflation rates

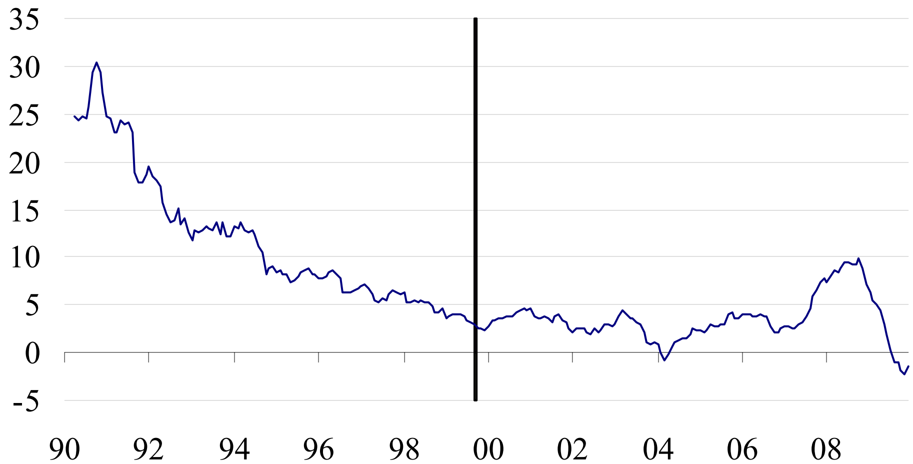
(percentage)



Source: National Statistics Institute, Chile.

Figure 3. Annual CPI inflation rates

(percentage)

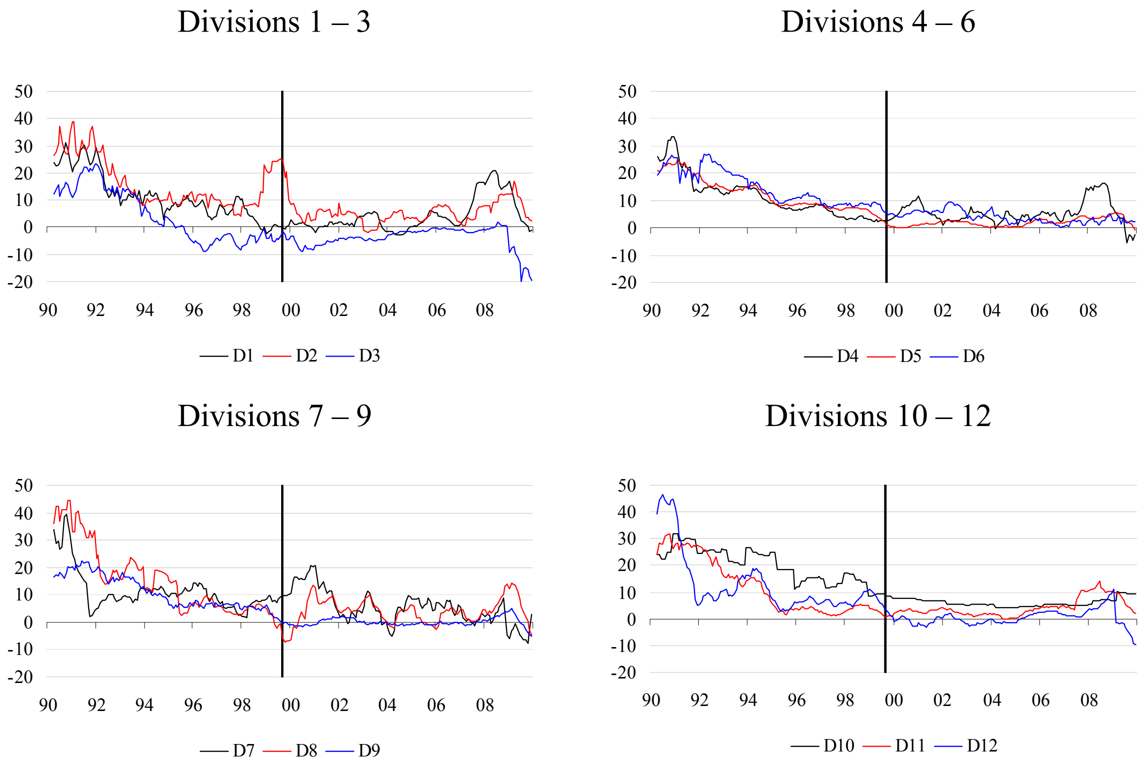


Source: National Statistics Institute, Chile.

Note: The vertical line indicates the adoption of the inflation targeting regime.

Figure 4. Annual inflation rates

(percentage)

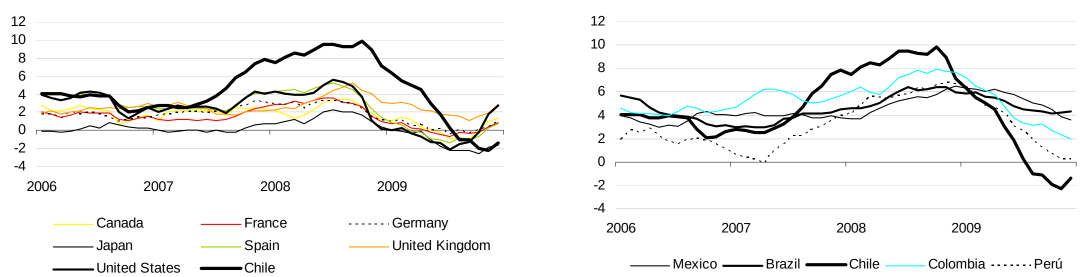


Sources: Pedersen et al. (2009) and National Statistics Institute, Chile.

Note: The vertical lines indicate the adoption of the inflation targeting regime.

Figure 5. CPI inflation rates

(percentage)



Sources: International Monetary Fond and national statistics institutes.

Table 1. Weights in the total CPI basket

(percentage)

Division	Name of Division	1989	1998	2008
D1	Food and non-alcoholic beverages	28.4	22.2	17.9
D2	Alcoholic beverages and tobacco	2.5	2.1	2.1
D3	Wearing apparel and footwear	8.1	7.3	5.1
D4	Housing, water, electricity, gas and other fuels	16.2	13.7	12.7
D5	Furnishings, items for the household and for routine household maintenance	7.6	9.5	7.2
D6	Health	3.9	6.0	5.5
D7	Transport	15.1	11.7	18.7
D8	Communications	1.4	3.1	4.0
D9	Recreation and culture	5.0	6.9	9.2
D10	Education	3.3	6.0	6.2
D11	Restaurants and hotels	4.7	4.2	5.9
D12	Miscellaneous goods and services	3.8	7.3	5.4

Source: National Statistics Institute, Chile.

Note: The column “1989” refers to the CPI with base April 1989 = 100; “1998” to the CPI with base December 1998 = 100 and “2008” to the CPI with base December 2008 = 100.

Table 2. Descriptive statistics

	Full sample				Apr.90 – Aug.99				Sep.99 – Dec.09			
	μ	σ	Min	Max	μ	σ	Min	Max	μ	σ	Min	Max
CPI	7.4	6.6	-2.3	30.4	11.8	7.0	3.2	30.4	3.5	2.4	-2.3	9.9
D1	7.6	8.1	-3.0	31.3	11.5	8.5	-2.6	31.3	4.1	6.0	-3.0	20.8
D2	10.8	8.9	-1.8	38.9	16.4	9.2	4.1	38.9	5.7	4.3	-1.8	24.7
D3	0.0	8.3	-19.8	23.3	4.3	9.6	-8.9	23.3	-3.9	4.1	-19.8	1.8
D4	8.3	6.8	-5.5	33.5	11.5	7.7	2.3	33.5	5.4	4.1	-5.5	16.4
D5	6.9	6.7	-1.0	24.8	12.4	5.9	2.0	24.8	2.0	1.4	-1.0	5.7
D6	9.1	7.2	0.2	27.0	14.9	6.3	5.8	27.0	3.9	2.1	0.2	9.3
D7	8.2	7.5	-7.6	39.6	11.4	7.5	1.5	39.6	5.4	6.2	-7.6	20.8
D8	9.4	10.8	-7.4	44.3	15.3	12.3	-2.3	44.3	4.0	4.6	-7.4	14.2
D9	5.2	6.9	-5.0	22.3	10.9	6.0	0.3	22.3	0.1	1.6	-5.0	5.1
D10	12.7	8.3	4.0	32.0	20.0	6.4	8.6	32.0	6.1	1.5	4.0	10.2
D11	8.0	8.4	-0.3	31.8	12.1	10.1	0.7	31.8	4.1	3.3	-0.3	14.0
D12	6.2	10.1	-9.8	46.4	12.7	11.2	3.0	46.4	0.3	3.0	-9.8	11.2

Source: Author's calculations.

Note: The column "μ" reports the mean, "σ" the standard deviation, "Min" and "Max" the minimum and maximum values, respectively.

Table 3. ADF tests

	Full sample	Apr.90 – Aug.99	Sep.99 – Dec.09
Test value	-3.18	-2.85	-3.99
p-value	0.00	0.00	0.00

Source: Author's elaboration.

Note: Lags are selected according to the Schwarz criterion allowing for a maximum of 12 lags. In the full sample and the early subsample, neither the trend nor the constant is statistically significant. In the late subsample the constant is significantly different from zero.

Table 4. Lags included in the VARs according to information criteria

	Full sample	Apr.90 – Aug.99	Sep.99 – Dec.09
Obs.	237	113	124
M1	10 / 2 / 2	5 / 1 / 5	6 / 2 / 4
M2	12 / 1 / 1	10 / 1 / 5	6 / 2 / 2
M3	9 / 2 / 2	5 / 2 / 5	12 / 7 / 7
M4	9 / 2 / 2	5 / 1 / 5	11 / 2 / 2
M5	12 / 3 / 9	9 / 1 / 5	6 / 2 / 6
M6	11 / 3 / 6	6 / 5 / 6	8 / 2 / 2
M7	10 / 2 / 5	5 / 1 / 1	4 / 4 / 4
M8	11 / 1 / 5	12 / 1 / 5	8 / 2 / 4
M9	9 / 1 / 1	5 / 1 / 1	12 / 2 / 2
M10	10 / 1 / 12	5 / 1 / 1	6 / 1 / 4
M11	9 / 1 / 2	12 / 1 / 1	6 / 2 / 6
M12	12 / 3 / 11	12 / 3 / 5	11 / 2 / 4

Source: Author's elaboration.

Note: M1 refers to the propagation model of inflationary shocks to D1, M2 to the model of inflationary shocks to D2, etc. X / Y / Z indicate the selected lag length according to the information criteria of Akaike / Schwarts / Hannan-Quinn.

Table 5. Propagation of shocks in D1 - 12

	Effect in the months indicated (percentage points)						Months with significant effect	
	0	3	6	12	24	Max	First	Last
				D1				
Full sample	**0.11**	**0.20**	**0.21**	**0.21**	0.18	**0.21** (9)	0	12
90:4 – 99:8	**0.14**	**0.18**	0.18	0.17	0.13	**0.18** (4)	0	4
99:9 – 09:12	0.02	0.25	**0.32**	0.22	0.07	**0.32** (6)	4	8
				D2				
Full sample	0.00	-0.04	-0.02	0.00	0.01	-0.05 (2)		
90:4 – 99:8	0.00	-0.04	0.02	0.08	0.08	0.09 (18)		
99:9 – 09:12	-0.01	-0.03	-0.05	-0.02	-0.06	-0.06 (10)		
				D3				
Full sample	0.00	0.12	0.14	0.17	0.18	0.18 (23)		
90:4 – 99:8	0.04	0.19	0.19	0.18	0.15	0.19 (4)		
99:9 – 09:12	-0.08	-0.04	-0.02	0.00	0.01	-0.08 (0)		
				D4				
Full sample	**0.21**	**0.35**	**0.38**	**0.39**	**0.33**	**0.39** (10)	0	27
90:4 – 99:8	**0.35**	**0.49**	**0.52**	**0.52**	0.43	**0.53** (8)	0	17
99:9 – 09:12	**0.12**	**0.32**	**0.37**	0.27	0.07	**0.37** (6)	0	11
				D5				
Full sample	**0.27**	**0.83**	**0.84**	**0.77**	**0.64**	**0.85** (4)	0	39
90:4 – 99:8	**0.36**	**1.06**	**1.10**	**1.07**	**0.97**	**1.10** (6)	0	35
99:9 – 09:12	-0.01	0.07	-0.12	-0.42	-0.19	0.08 (2)		
				D6				
Full sample	0.11	0.12	0.11	0.10	0.07	0.12 (2)		
90:4 – 99:8	**0.15**	0.15	0.12	0.08	0.04	0.17 (1)	0	0
99:9 – 09:12	0.01	-0.08	-0.13	-0.16	-0.12	-0.16 (12)		

				D7				
Full sample	**0.10**	**0.19**	**0.23**	**0.25**	**0.23**	**0.25** (13)	0	39
90:4 – 99:8	**0.18**	**0.27**	**0.31**	**0.35**	0.31	**0.35** (13)	0	17
99:9 – 09:12	**0.05**	**0.15**	0.16	0.12	0.05	**0.16** (5)	0	5
				D8				
Full sample	0.00	0.04	0.03	0.02	0.01	0.04 (2)		
90:4 – 99:8	0.02	**0.15**	**0.18**	**0.17**	**0.13**	**0.18** (7)	2	25
99:9 – 09:12	0.00	-0.14	**-0.27**	**-0.28**	-0.08	**-0.30** (9)	4	16
				D9				
Full sample	-0.05	-0.07	-0.05	-0.03	-0.01	-0.07 (2)		
90:4 – 99:8	-0.07	-0.10	-0.05	0.00	0.03	-0.13 (1)		
99:9 – 09:12	0.01	-0.02	-0.43	-0.76	-0.05	-0.76 (12)		
				D10				
Full sample	-0.02	-0.05	-0.07	-0.09	-0.09	-0.09 (20)		
90:4 – 99:8	-0.03	-0.06	-0.08	-0.10	-0.08	-0.10 (12)		
99:9 – 09:12	0.00	-0.40	**-0.78**	**-1.26**	-1.13	**-1.37** (16)	5	20
				D11				
Full sample	**0.23**	**0.55**	**0.52**	**0.44**	**0.32**	**0.55** (3)	0	25
90:4 – 99:8	**0.28**	**0.57**	**0.53**	**0.46**	**0.36**	**0.58** (2)	0	25
99:9 – 09:12	0.14	**0.50**	**0.46**	0.27	0.07	**0.51** (4)	2	6
				D12				
Full sample	0.03	-0.02	0.10	**0.21**	**0.22**	**0.24** (18)	11	53
90:4 – 99:8	**0.18**	0.01	0.17	**0.38**	**0.35**	**0.40** (16)	9	36
99:9 – 09:12	-0.04	-0.04	0.01	0.04	0.02	-0.06 (1)		

Source: Author’s elaboration.

Notes: Bold numbers indicate significant values. The columns “0” to “24” report the responses after 0, 3, etc. months. “Max” is the maximum response in absolute value with the month in parentheses. “First” and “Last” are the first and last months with significant responses.

Table 6. Effect on core CPI of a unit shock to food prices

(percentage points of annual inflation rate)

	First(a)	Last(a)	3M(b)	6M(b)	12M(b)	07:7-09:3(c)	09:8-09:12(d)
Chile	4	11	0.14	0.23	0.23	16.1	0.0
USA	n/a	n/a	-0.04	-0.05	-0.07	5.8	-2.4
Canada	4	7	0.08	0.11	0.08	3.9	2.4
Japan	3	5	0.03	0.04	0.01	2.3	-1.9
Germany	5	20	0.04	0.07	0.10	5.0	-2.5
France	5	22	0.03	0.10	0.17	3.7	-0.7
Spain	1	8	0.31	0.34	0.13	4.9	-2.3
UK	0	18	0.09	0.10	0.11	7.9	1.7
Brazil	0	10	0.19	0.27	0.23	12.7	1.4
Mexico	0	31	0.12	0.19	0.21	7.9	7.0
Colombia	n/a	n/a	0.06	0.11	0.14	10.2	1.1
Peru	5	10	0.08	0.13	0.17	8.3	0.7

Source: Author's elaboration.

Notes: (a) First (last) month with statistically significant effect. (b) Effect after respectively 3, 6 and 12 months. (c) Average annual inflation rate calculated for the months indicated in the first row, where the inflation of the Chilean food component was higher than 10%. (d) Average annual inflation rate calculated for the months indicated in the first row, where the Chilean inflation of the food component was less than 2%.

Table 7. Effect on core CPI of a unit shock to energy prices

(percentage points of annual inflation rate)

	First[(a)]	Last[(a)]	3M[(b)]	6M[(b)]	12M[(b)]	07:10 - 8:10[(c)]	08:12 - 09:12[(d)]
Chile	1	12	0.07	0.08	0.06	18.3	-9.8
USA	3	3	0.01	0.01	0.00	19.8	-17.1
Canada	0	0	0.00	0.01	0.01	12.3	-12.6
Japan	1	15	0.03	0.04	0.04	10.1	-10.5
Germany	2	4	-0.02	-0.02	0.00	10.8	-4.9
France	n/a	n/a	-0.01	-0.01	0.01	12.7	-10.9
Spain	4	11	0.03	0.05	0.04	14.0	-8.6
UK	n/a	n/a	0.01	0.00	0.00	14.5	1.3
Brazil	0	9	0.11	0.13	0.09	-1.5	2.5
Mexico	n/a	n/a	0.02	0.01	0.02	5.4	2.7
Colombia	1	8	0.08	0.10	0.08	9.6	5.1
Peru	0	8	0.06	0.08	0.08	2.1	-3.1

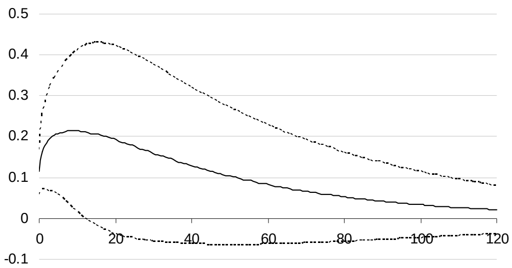
Source: Author's elaboration.

Notes: (a) First (last) month with statistically significant effect. (b) Effect after respectively 3, 6 and 12 months. (c) Average annual inflation rate calculated for the months indicated in the first row, where the inflation of the Chilean energy component was higher than 10%. (d) Average annual inflation rate calculated for the months indicated in the first row, where the Chilean inflation of the energy component was less than 2%.

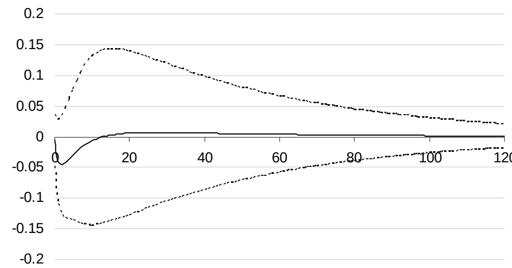
Figure A1. Responses on CPI- from a unit shock to D1 – D12. Full sample

(percentage points)

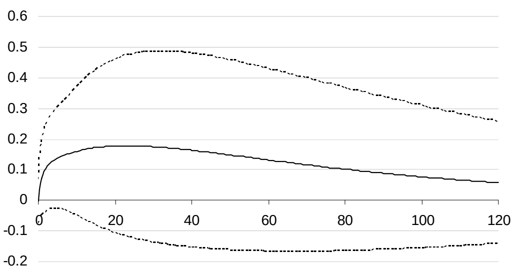
D1



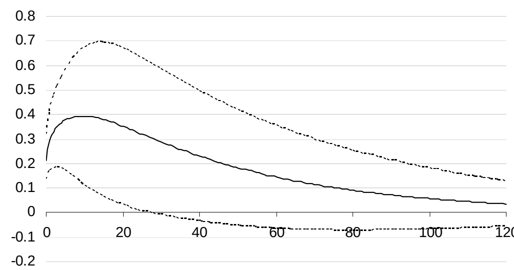
D2



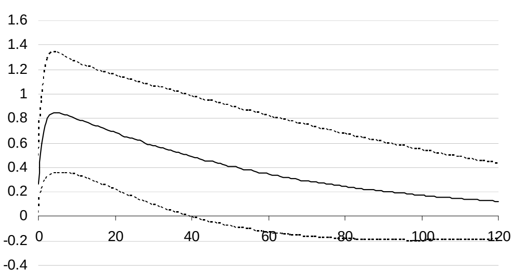
D3



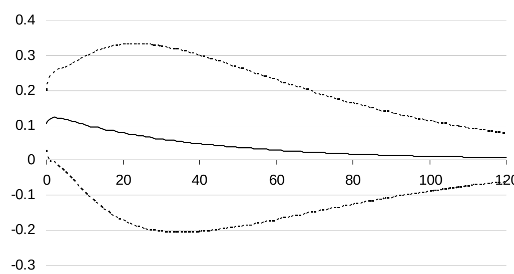
D4



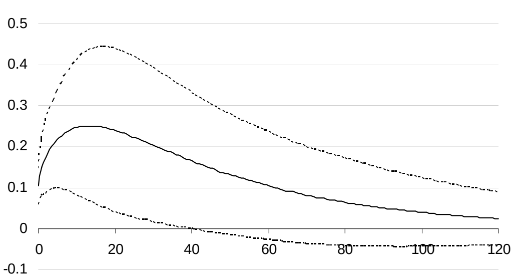
D5



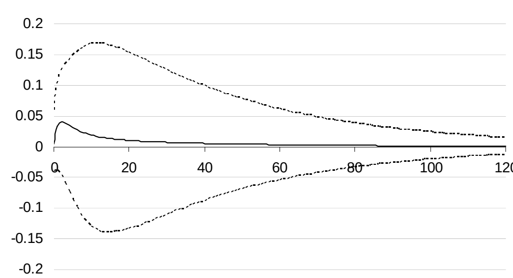
D6



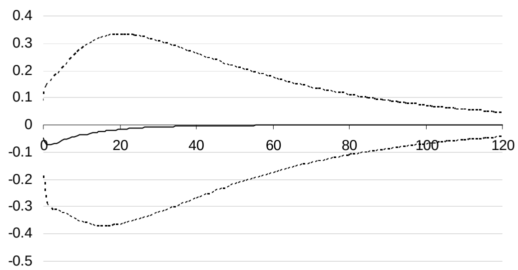
D7



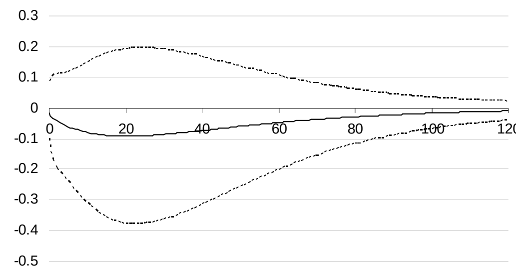
D8



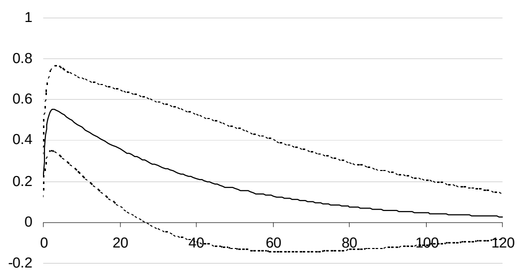
D9



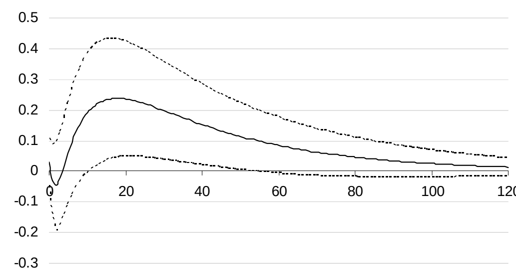
D10



D11



D12



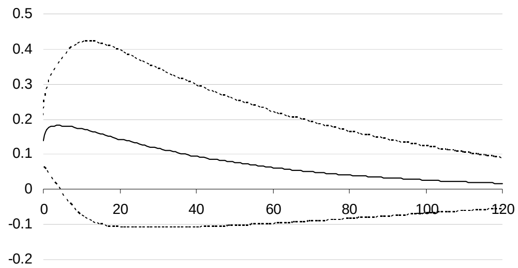
Source: Author’s elaboration.

Note: Punctuated lines indicate two times the standard deviation.

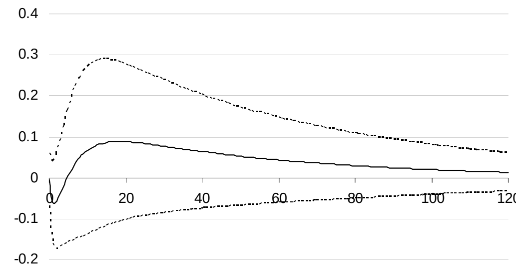
Figure A2. Responses on CPI- from a unit shock to D1 – D12. 1990:4 – 1999:8

(percentage points)

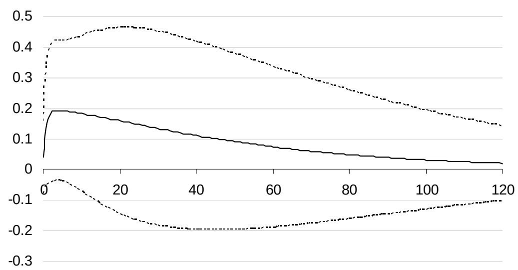
D1



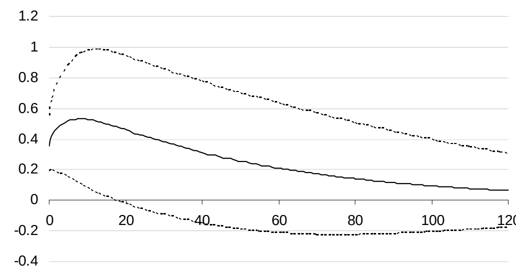
D2



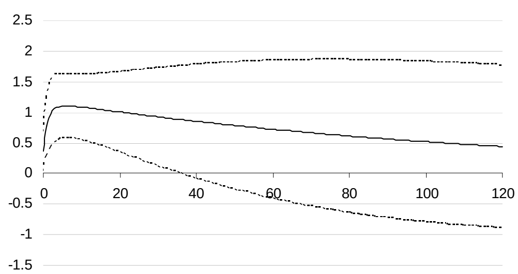
D3



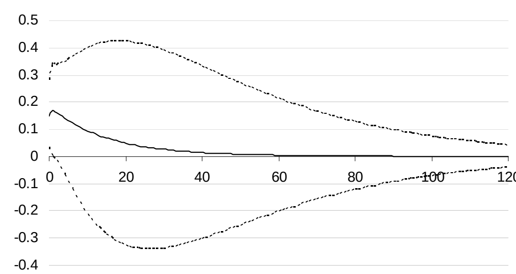
D4



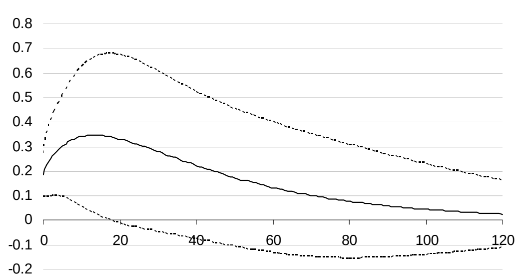
D5



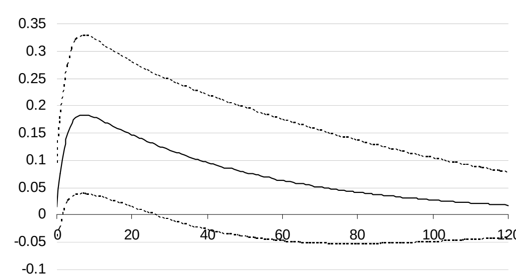
D6



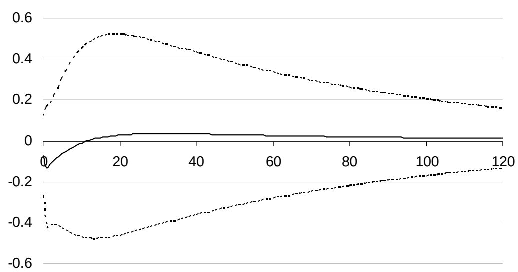
D7



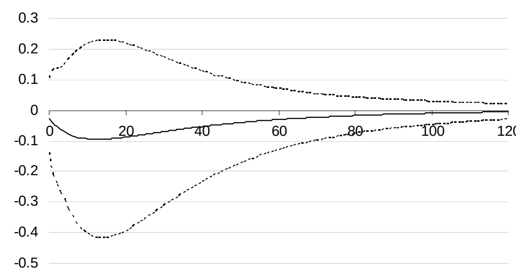
D8



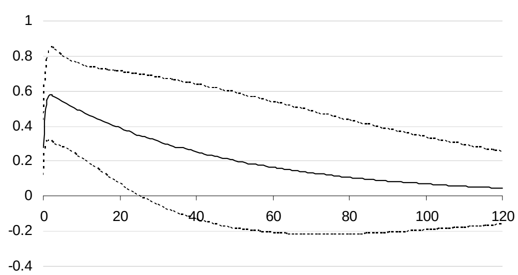
D9



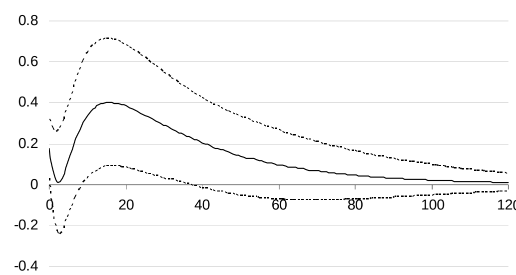
D10



D11



D12



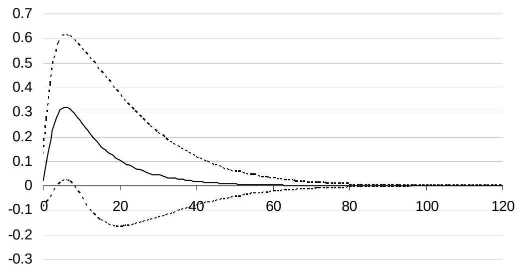
Source: Author's elaboration.

Note: Punctuated lines indicate two times the standard deviation.

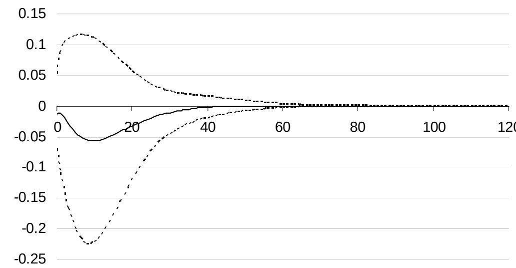
Figure A3. Responses on CPI- from a unit shock to D1 – D12. 1999:9 – 2009:12

(percentage points)

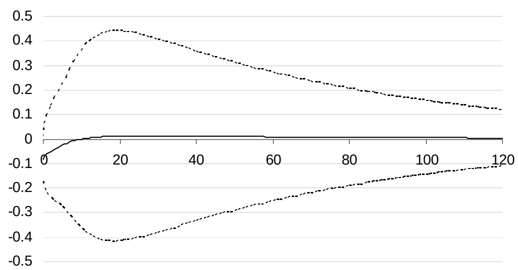
D1



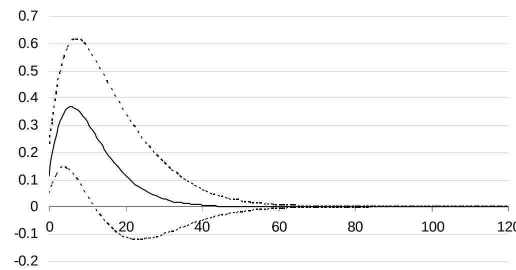
D2



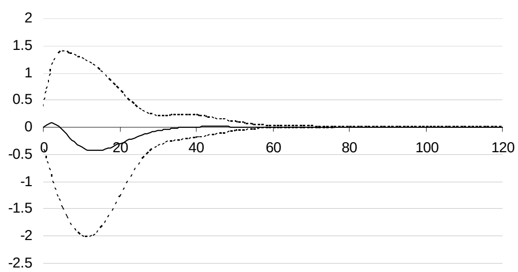
D3



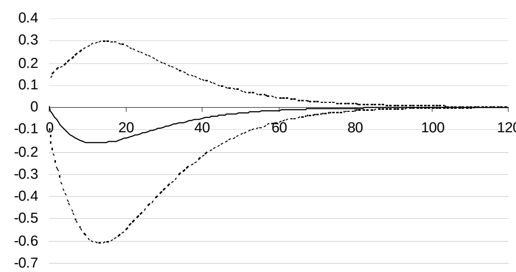
D4



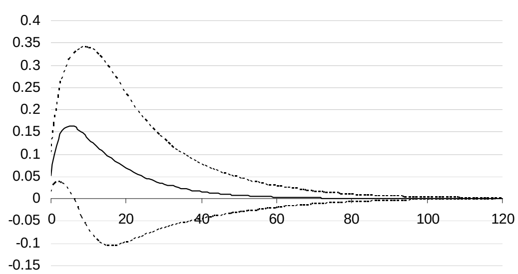
D5



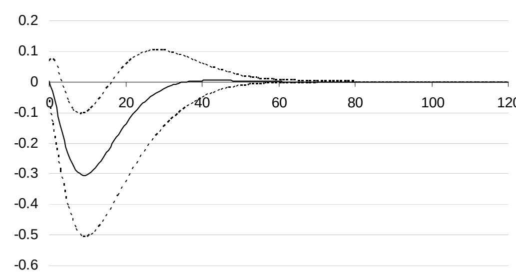
D6



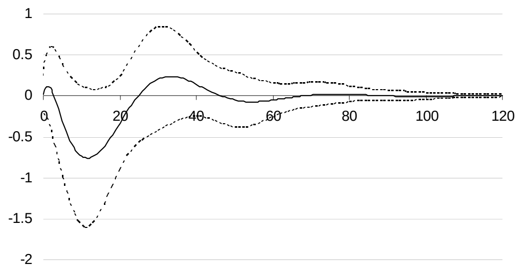
D7



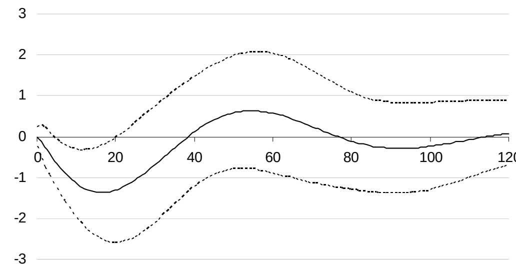
D8



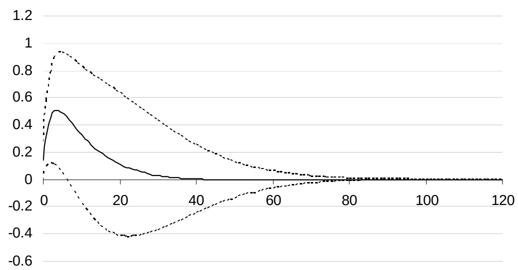
D9



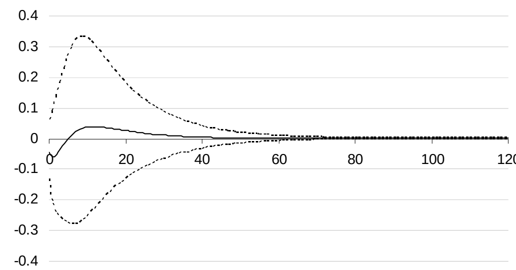
D10



D11



D12



Source: Author's elaboration.

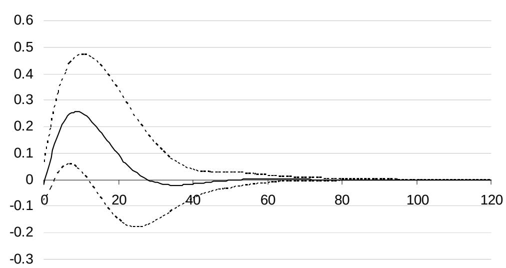
Note: Punctuated lines indicate two times the standard deviation.

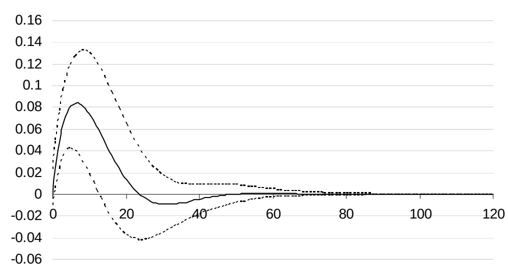
Figure B1. Responses on core CPI from a unit shocks to food and energy prices

(percentage points)

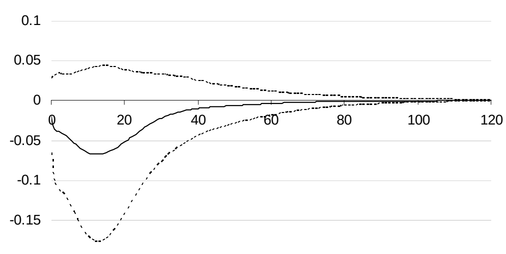
FOOD **ENERGY**

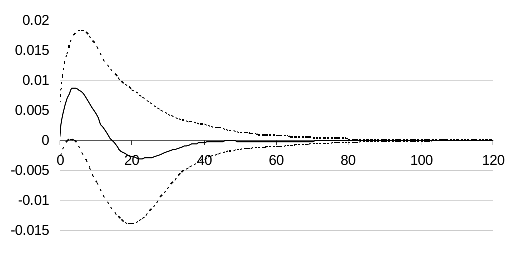
Chile



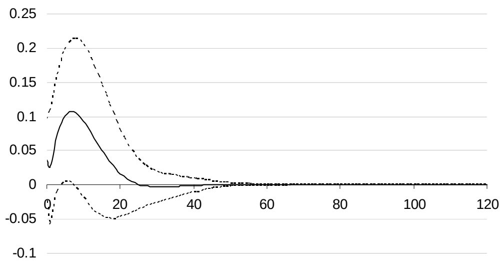


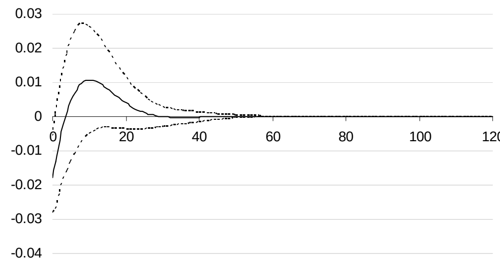
USA



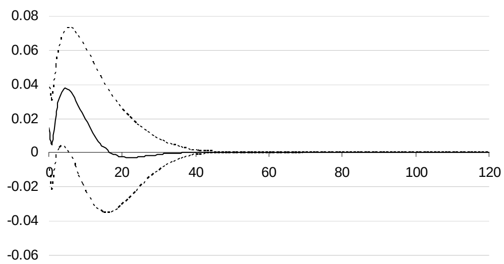


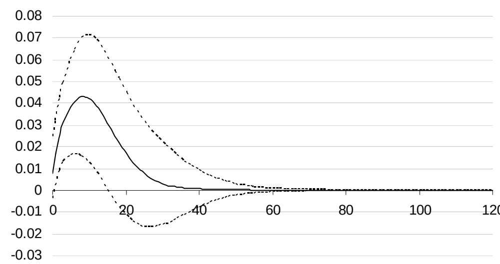
Canada



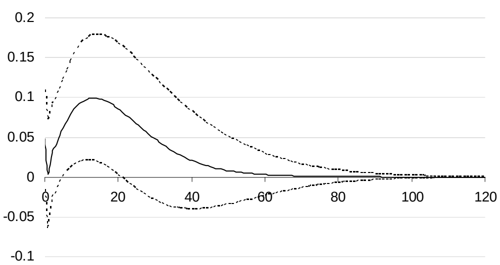


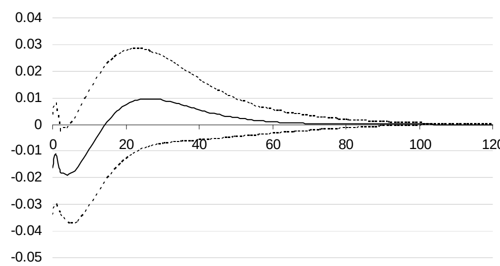
Japan



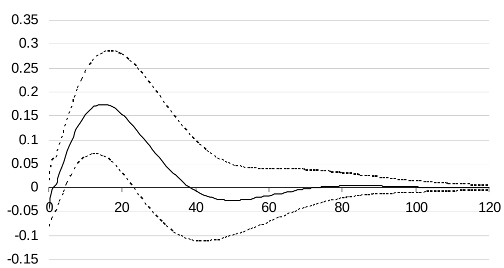


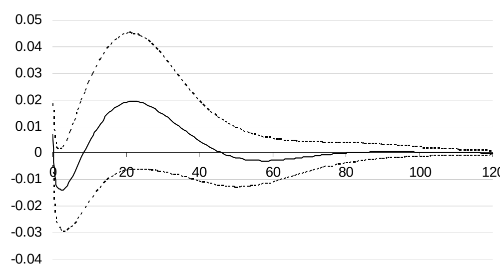
Germany



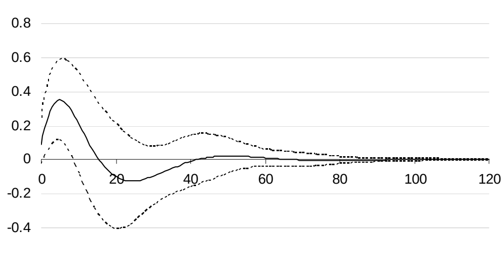


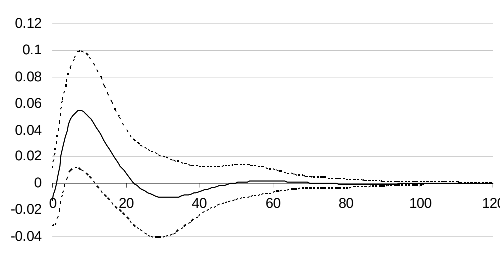
France



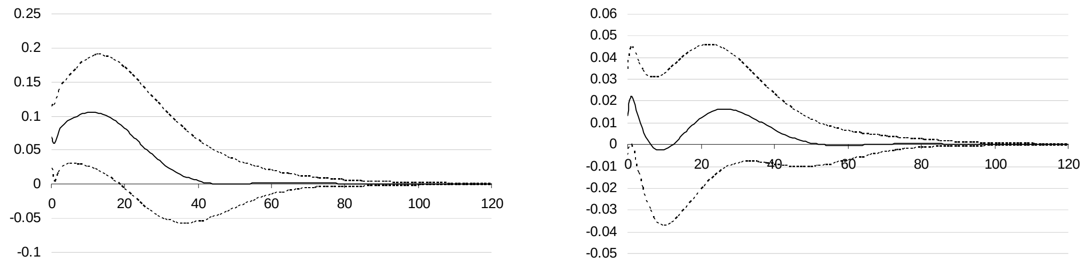


Spain

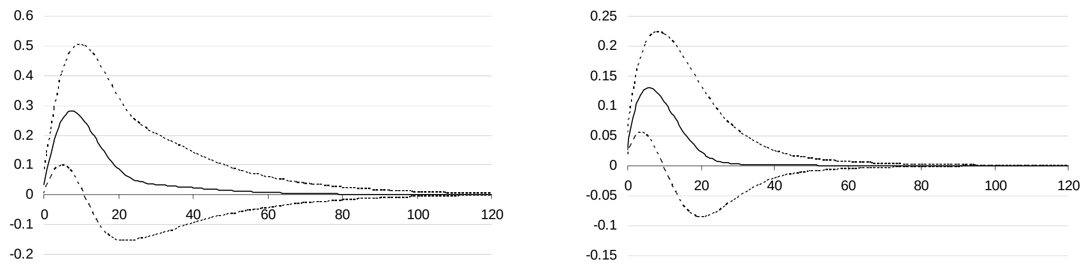




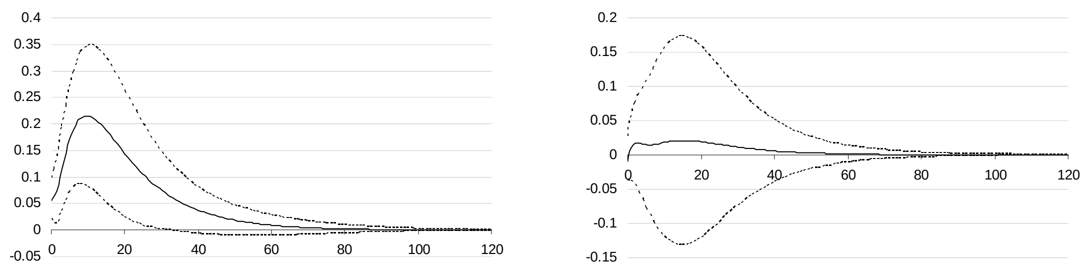
UK



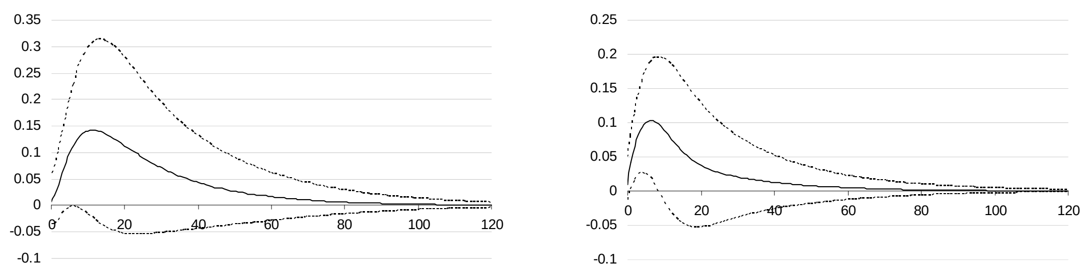
Brazil



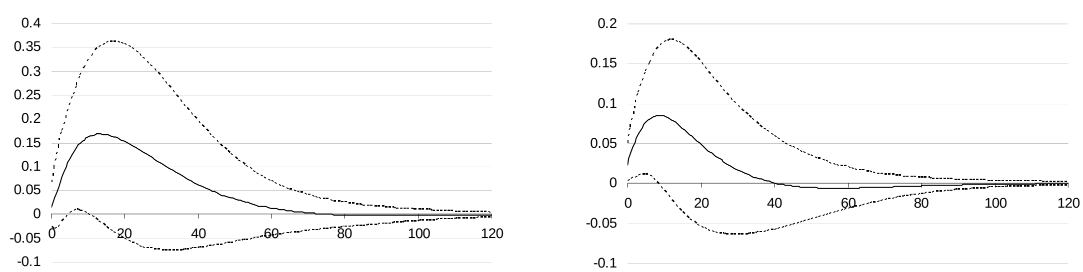
Mexico



Colombia



Peru



Source: Author's elaboration.

Note: Punctuated lines indicate two times the standard deviation.

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