PUBLIC INFORMATION AND INFLATION EXPECTATIONS:  
MICROECONOMETRIC EVIDENCE FROM A NATURAL EXPERIMENT

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Abstract—Governments provide public information to reduce information imperfections. Do households rely on public signals to inform themselves about market conditions? To identify the importance of public information in households’ price expectations, we take advantage of a unique natural experiment in Ecuador where the published inflation rate had been different from the correct rate over a period of fourteen months due to a software error. We find that the public signal about prices plays an important role in households’ price expectations, and the change in price expectations affects their savings choices. The effect is stronger for better-educated and older people.

I. Introduction

GOVERNMENTS provide public information about market conditions in part to reduce information imperfections and facilitate efficient allocation decisions in the economy. For example, consumer and producer price indices, indicators of aggregate economic activity such as GDP and the unemployment rate, are regularly published by government agencies in almost all countries in the world. Rational agents are expected to use both public signals and idiosyncratic information generated by their own experiences to form expectations about the future and make their consumption and investment decisions. Do agents rely more on their own private information or on public signals to inform themselves about market conditions?

This paper takes advantage of a unique natural experiment in Ecuador to identify the effects of the information provided by the government about prices (the published inflation statistics) on households’ expectations about the evolution of future prices. The evidence suggests that the public signal about prices plays an important causal role in the formation of households’ price expectations, and the changes in price expectations in turn affect their savings decisions. The effect is heterogeneous: the public price signal (published inflation rate) has a stronger effect on the price expectations of older people, better-educated families, and men.1 To the best of our knowledge, this is the first paper to provide credible microeconometric evidence on the causal effect of public information on household expectations formation.2

In an idealized Arrow-Debreu competitive economy, the equilibrium prices faced by the agents in their market interactions are sufficient statistics: They aggregate all the dispersed information across the economy in an efficient way. Thus, in such an environment, there is no role for any public signal, especially relating to prices. In a more realistic setting, the equilibrium prices faced by a household in any local market may not be sufficient statistics because of a lack of market integration (especially relevant in developing countries with underdeveloped infrastructure) and also due to imperfect and asymmetric information. Thus, the price data published by a central statistical agency (e.g., the CPI and inflation rate) can play a useful role in aggregating dispersed information in an economy and help households and firms better understand the prevailing market conditions. In an economy with an incomplete set of markets, other nonprice signals such as unemployment rate and output gap can also affect expectations of economic agents as to the likely evolution of prices in the economy. In the context of developing countries where the set of markets is rather limited, such quantity signals might be especially important.

Recent theoretical analysis shows that the importance of public information (signals) depends on the structure of interactions among agents (see, e.g., Angeletos & Pavan, 2007, 2008; Amador & Weill, 2008; Morris & Shin, 2002). Since public signals such as published statistics on economic activity or prices aggregate the dispersed information across the economy and thus reveal information about the actions of others, it is optimal for an individual agent (household) to put more weight on the public information when actions of different agents are strategic complements.

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1 The survey contains information regarding the direction of expected price change (Do you think that prices will increase in next twelve months?).

2 The potential importance of private and public information in the formation of inflation perception and expectations has long been understood and discussed in the literature. See, for example, Jonung (1981), Batchelor and Jonung (1986), Carroll (2003), Blanchflower and Kelly (2008), Blanchflower and MacConaile (2009), Fajfar and Santoro (2006, 2008), and Curtin (2005). A number of recent contributions also look at the role of news media in expectations formation, especially its influence on the heterogeneity and bias in inflation expectations (see, e.g., Badarinja & Buchmann, 2009; Maag & Lamla, 2009; Lamla & Lein, 2008). However, to the best of our knowledge, no empirical work to date disentangles the causal effects of publicly provided price information (published CPI) at the household level. As explained below, the challenge for identifying the effects of public information is that it is very difficult, if not impossible, to address the omitted variables bias that results from a lack of adequate controls for the private information set of the households.


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Naturally, the importance of the public signal is a positive function of the strength of complementarity. A growing theoretical literature on the social value of public information shows that what is critical for welfare analysis is the weight that agents put on public information relative to their idiosyncratic private information. The related literature on social learning and herd behavior shows that when individual agents rely more on public signals, they underuse their idiosyncratic information. This might create inefficient herd behavior and also retard the process of social learning (Banerjee, 1992; Amador & Weill, 2007). There is, however, a long tradition in development economics that emphasizes the potentially beneficial role of public signals in escaping from low-level equilibrium traps. When public signals are important in the formation of expectations of economic agents, the government may be able to coordinate expectations of private agents to attain Pareto-superior outcomes as emphasized in the literature on poverty traps and economic development (see, e.g., Murphy, Shleifer, & Vishny, 1989; Rodriguez-Clare, 1996; Ray, 1998; Hoff & Stiglitz, 2001; Bowles, Durlauf, & Hoff, 2006).

The literature on inflation expectations in developed countries is vast, but it is also limited at best in the context of developing countries. Most of the existing literature on inflation in developing countries uses aggregate macromodels and aggregate data (Jha, 2003; Agénor & Montiel, 1999). The focus of this paper is rather different compared to much of the literature on inflation in both developed and developing countries. It addresses the following question: How much does publicly provided price information affect the price expectations of the households? To the best of our knowledge, we provide the first credible microeconometric evidence on the causal effect of public information on household price expectations in the context of a developing country, Ecuador.5

We use a unique natural experiment in Ecuador to identify and estimate the relevance of public information (the published inflation rate) to households’ expectations about future prices. In March 2006, the National Bureau of Statistics of Ecuador (INEC) publicly announced a mistake on its consumer price index and inflation rate statistics. The mistake was attributed to a programming error that started in January 2005 after new software was introduced. In April 2006, a revised series for the past fourteen months was released. The resulting adjustments were large. For instance, the official annual inflation rate in February 2006 dropped from 5.3% to 3.8% (about a 40% upward bias in the incorrect published inflation rate) once the correction was made. This was an unexpected event considering that the INEC had been successfully measuring prices for almost forty years.

We use household survey data to analyze the effects of the variations in the published inflation statistics arising from the programming error on households’ survey expectations regarding future prices. The data set is a monthly survey that the Central Bank of Ecuador uses to compute employment statistics and consumer confidence indexes in the three largest urban areas of the country. The survey contains information on households’ expectations about future prices, as well as their individual characteristics (education, age, gender, and income). Following the literature, we model price expectations as a function of households’ inflation perceptions, which in turn depend on public and private information, and households’ demographic characteristics (Jonung, 1981). Probably the most important difficulty in isolating the effects of public information on price expectations is to find adequate controls for the private information available to the households through the daily market interactions, for example, at grocery stores, gas stations, and department stores. In the absence of adequate controls for the local information, public signals such as published inflation statistics will also reflect the private information because the CPI would be correlated with the local prices. We address this problem in three steps. First, we measure the public signal as the part of incorrect inflation that is solely due to the programming error: the gap between the incorrect and revised inflation rates. If households pay little attention to the published inflation statistics and rely

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3 One can make an argument that the role of public information in developing countries is limited by lack of education and paucity of information transmission channels. However, because developing countries are also relatively information poor, it is more likely that public information is not crowded out in the competition for scarce attention of the economic agents (Falkinger, 2008). On a priori grounds, it is thus not ambiguous whether public information plays a stronger role in developing or developed countries.

4 The focus of a large part of the literature, especially in the context of developed countries, has been on relaxing the assumptions of the rational expectations model to better explain the dynamics of inflation observed in the data (see, e.g., Batchelor & Jonung, 1986; Sargent, 1993; McCullum, 2002; Pesaran, 1989). The related literature on the new Keynesian Phillips curve has been an active area of research with influential contributions (Gali & Gertler, 1999; Gali, Gertler, & Lopez-Salido, 2005; Woodford, 2003; Roberts, 1997; Fuhrer & Moore, 1995). The more recent literature on the sticky information (or rational inattentive agent) models of inflation expectations emphasizes the possibility that rational agents update their inflation expectations only periodically given the cost of acquiring price information (see, e.g., Mankiw et al., 2003, Mankiw & Reis, 2006; Sims, 2003; Woodford, 2003; Carroll, 2003; Souleles, 2004; Klenow & Willis, 2007; Blanchflower & MacCoile, 2009). There is also a growing literature, again in the context of developed countries, that focuses on the heterogeneity in inflation expectations (see, e.g., Bryan & Venkat, 2001a, 2001b; Mankiw et al., 2003, Mankiw & Reis, 2006; Branch, 2004, 2007; McGrawan & Paulson, 2005; Blanchflower & MacCoile, 2009; Pfajfar & Santoro, 2006, 2008).

5 To the best of our knowledge, there is no work that analyzes the effects of public signals on price expectations in developing countries. Even in developed countries, the literature on modeling the actual inflation expectations of households using survey data is rather limited, as Carroll (2003) emphasized recently. Most of the work on inflation dynamics either uses time series macrodata or focuses on explaining the central tendency in the household survey data using the time variations for identification. For example, the dependent variable in the extensive analysis in Mankiw et al. (2003) is the median inflation expectations. Recent exceptions include Bryan and Venkat (2001a, 2001b), Branch (2004, 2007), Pfajfar and Santoro (2008), Blanchflower and MacCoile (2009), and Carroll (2003).
primarily on private information, the error due to the mistake in programming should not affect their price expectations. Second, and more important, the natural experiment allows us to use the revised inflation rate as an excellent control for the correlated private information. The revised CPI and inflation rate during the fourteen-month period when INEC had been publishing the incorrect CPI was unobservable to households. The unobserved inflation rate should not influence the price expectations on its own; it can affect household price expectations only if it is correlated with a private information set and thus works as a proxy variable for the private information. The unobserved inflation rate captures that part of the private information set correlated with the prices of the items covered in the CPI basket. Finally, in all of the specifications, we employ city and month (time) fixed effects to capture omitted heterogeneity in inflation expectations that focus on forecast error and bias. 

6 In the absence of the programming error, it is extremely difficult, if not impossible, to control for the correlated private information that households gather through their daily market and social interactions. For example, in addition to price information in the grocery store, we also need data on price information that comes from friends and coworkers. We emphasize here again that omitted private information causes bias in the estimated effects of public information only if the private information is correlated with the public signal, and the revised CPI (unobserved at the time) captures precisely that part of the private information correlated with the published (incorrect) CPI.

7 As noted in the literature, the heterogeneity in price expectations can arise from three sources: differences in (a) information sets, (b) cognitive ability for processing information, and (c) models or predictor functions (for a lucid discussion, see Pfajfar & Santoro, 2008). At any given period, a household would acquire information on only a small subset of the relevant variables as information acquisition is costly and depends on the availability of information channels. For interesting evidence on the importance of cost-benefits calculus in information acquisition for inflation expectations in Sweden, see Batchelor and Jonung (1986). Even if information is available at no cost, different individuals are likely to have different information sets because of bounded rationality considerations (Sims, 2006). The importance of public signals may thus depend on demographic characteristics such as education, age, gender, and income. However, our results on the heterogeneous effects of public information on price expectations are not directly comparable to the existing evidence on the heterogeneity in inflation expectations that focus on forecast error and bias.

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8 It is well understood in the literature that inflation expectations can potentially affect the savings behavior of the households. See, for example, Pfajfar and Santoro (2008).
II. Measuring Prices in Ecuador

A. Country Background

Ecuador is a developing country in South America. In 2006, its per capita GDP was close to $3,200, lower than most of the other countries on this continent except Bolivia and Paraguay. Ecuador’s economy relies heavily on the oil industry. Oil exports accounted for about 55% of its total exports, and more than 25% of the central government revenue came from oil-related royalties in 2006.

Ecuador suffered a severe financial crisis at the end of 1999 that precipitated a collapse of the banking system and a contraction of more than 6% in GDP. By December 1999, the national currency (sucre) had depreciated 195% over the past year, and the inflation rate accelerated from an annual rate of 27% in January 1998 to 78% in January 2000. In January 2000, a presidential decree approved a series of structural reforms to address ongoing crisis, including adoption of the U.S. dollar as the legal currency of the country (“dollarization” in popular parlance). A slow economic recovery followed. Higher oil prices and increased remittances helped the country achieve an average annual growth rate close to 5% from 2001 to 2006. In addition, inflation drastically decreased from a peak of 108% in September 2000 to 16% in January 2002 and less than 2% by the end of 2004. Figure 1 shows the steady decline in inflation rates until the end of 2004. From this point on, inflation rates seemed to stabilize at around 4%.

B. The Ecuadorian National Institute of Statistics: Methods and Credibility

Soon after its creation in 1976, the Ecuadorian National Institute of Statistics (INEC) started to compute consumer price index (CPI) data on a monthly basis. On the first workday of each month, the institute generally releases CPI data for the previous month. The INEC provides the official inflation estimate, which is used for all legal matters in the country. Consistent with international practice, the CPI is computed as a weighted average of the prices of a representative basket of goods and services. Prices of goods are collected from market transactions, including those in the formal (shops and grocery stores) and informal sectors (street vendors). As in most other countries, the Ecuadorian CPI basket does not include goods traded in the black economy; however, black markets in Ecuador are not important for the average household. The basket, weights, and base year of the CPI basket are determined using information from the most recent income-and-expenditure survey.

At the time of our study, the markets in Ecuador were not subject to any significant government intervention. As a result, there were no illegal markets of food or other products that are part of the CPI basket. The black markets in Ecuador facilitated transactions of illegal drugs, weapons, and other products that are not part of the CPI.

Income and expenditure surveys are carried out by the INEC. The latest surveys were performed in 1975 (July 1975–June 1976), 1994 (September 1994–August 1995), and 2003 (February 2003–January 2004).
The INEC’s director is appointed by the president. The lack of independence from the executive power may compromise the credibility of its statistics. However, manipulation of price statistics by INEC for political purpose has not been a serious concern in Ecuador. The INEC follows a strict methodology to construct the CPI, which limits the institute’s ability to modify its estimates to suit political goals. Its CPI and inflation estimates are deemed credible enough to be used by several international organizations such as the IMF and World Bank in their official statistics.

C. The Natural Experiment: INEC’s “Mistake”

Until December 2004, INEC constructed the CPI using a basket of approximately 195 goods and services that was determined using an income-and-expenditure survey from September 1994 to August 1995. From February 2003 to January 2004, a new survey was implemented, and a basket of 299 goods and services was selected. The INEC used this new basket to change the base year of the CPI, and starting in January 2005, its computation was based on this new basket (INEC, 2005). On March 19, 2006, the INEC publicly announced a mistake that affected the CPI indices published over the previous fourteen months. The revised CPI statistics for the fourteen-month period were published on April 5, and the resulting adjustments were large. For instance, as shown in figures 2 and 3, the national annual inflation rate in February 2006 dropped from 5.3% to 3.8% once the correction was made.

We are not aware of any formal government publication that documents the details of this event except for a footnote in a statistical report published by the Central Bank of Ecuador (Banco Central del Ecuador, 2006, table 4.1.1a, note 1). To understand the nature of the INEC’s mistake, we interviewed several staff members of the INEC, the Central Bank of Ecuador, and other government agencies and examined internal reports and presentations. The mistake was attributed to an error in the programming code, a bug in the software that the INEC used to compute the CPI. Essentially the error overestimated the price of housing and underestimated the prices of food and beverages. Other products were unaffected. As shown in figure 4, the adjustments in housing prices are particularly large. To estimate the housing CPI, the INEC measures the rents of a sample of rental units in urban areas. Rental units in the sample are visited twice a year (once every six months). That is, about one-sixth of the units in the sample are visited each month, the gross rent paid by the tenants is recorded, and a six-month rental change is estimated. After the base year was changed, INEC’s software incorrectly imputed this six-month change as a one-month change. This error can introduce large upward biases in the CPI statistics. For instance, if rental prices grow by 6% a year, the INEC’s (incorrect) estimates would predict an annual 40% increase.

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12 Other types of government statistics (such as GDP growth) may be more vulnerable to adjustments due to political pressure by the government and thus likely to be less credible.

13 The new basket includes several items that households consumed in 2004 but were not available in 1994; these include cell phones, DVD players, and personal computers, for example (INEC, 2005).


15 The INEC’s press release on March 19, 2006, briefly described the error in the housing component of the CPI. When the revised series were released, the mismeasurement of both food and housing components was acknowledged (see, e.g., El Universo, April 6, 2006, p. A2; Expreso, April 6, 2006, p. 7; and Dinero, Diario de Negocios, April 6, 2006, p. 1).
To measure the prices of food and beverages, the INEC collects information on prices of a large number of fruits, vegetables, cereals, and beverages. Most of these data are gathered twice a month—(once every two weeks). After the data are collected, a two-week price change is computed. INEC’s software incorrectly imputed this two-week price change as a one-month change, introducing a negative bias in the CPI statistics (see figure 5).

Until July 2005 the downward bias in the prices of food and beverages was larger than the positive bias in the rental price. Thus, from January to July 2005, the correctly computed CPI was higher than the one that was originally reported. From July 2005 to February 2006, the positive biases were larger. The mistake in the INEC’s CPI software was a random event. Furthermore, the magnitude of the adjustment is different in each of the three largest urban areas in Ecuador (see figure 6). We use the variations in the published CPI series created by the programming error to analyze the relationship between the household expectations about future prices and the information provided by the govern...
III. Conceptual Framework and Econometric Strategy

A. Conceptual Framework

The expectation formation can then be described as:

$$E_{i(t)}(X_{t+1}) = G(\pi_{i(t)}, Z_{i(t)}, \epsilon_i),$$

where the expectation regarding period \(t+1\) is formed at period \(t\); \(Z\) and \(\epsilon\) are observable and unobservable individual or household characteristics, respectively, that may affect expectations formation; and \(G\) is a well-defined function. The vector \(Z\) includes characteristics of households such as education and age, and \(\epsilon\) is a scalar that captures the idiosyncratic unobserved differences across households.

Following the literature (Jonung, 1981; Jonung & Laidler, 1988), inflation perceptions are formed at period \(t\) using two sources of relevant information: public \(\Omega_{p(t)}\) and private \(\Omega_{d(t)}\) information sets:

$$\pi_{i(t)} = H(\Omega_{i(t)}, \Omega_{p(t)}, Z, \epsilon_i).$$

Substituting equation (2) into (1), we obtain

$$E_{i(t)}(X_{t+1}) = F(\Omega_{i(t)}, \Omega_{p(t)}, Z, \epsilon_i),$$

where \(F\) is a continuous and well-behaved function.

As discussed before, the typical elements in the private information set \(\Omega_{d(t)}\) are prices faced in the daily market interactions and price information learned from family, friends, and neighbors. The public information set consists of primarily the statistics published by government statistical agencies. In addition, professional inflation forecasts and independent media reports might be relevant, but they are rare in a developing country.

Do households and individuals collect public information every period or only periodically? Recent work suggests that agents may be rationally inattentive, that is, they may

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16 One might wonder if we can also use data from periods outside the experiment in conjunction with the natural experiment. We believe that data from other periods are in general not helpful precisely because of the fact that there is no way to control for the correlated private information. There is an additional complication when one considers data from the period following the announcement of the mistake by INEC and publication of the revised inflation series. The acknowledgment of the mistake must have affected the credibility of INEC, and thus the data from before and after the announcement are not likely to be comparable.

17 We are grateful to an anonymous referee for directing our attention to the close link between inflation perceptions and expectations and to Lars Jonung for guidance on this issue.

18 In an early analysis of inflation in Sweden, Jonung (1981) shows that the public’s expected inflation depends on perceptions about past inflation. The perception is formed using “two sets of data: (a) the public’s recollection of price indices, collected and published primarily by government agencies, and (b) the individual’s own experience of surveying prices and purchasing goods and services” (p. 962).

19 Carroll (2003) develops and estimates an inflation expectations formation model using data from the United States, where the general public adopts professionals’ forecasts with a certain probability rather than trying to form their own rational forecast.
collect information about public price signals only periodically given the costs of acquiring information (Sims, 2003; Mankiw, Reis, & Wolfers, 2003; Mankiw & Reis, 2006; Woodford, 2003; Branch, 2007; Carroll, 2003, Klenow & Willis, 2007). These insights have interesting implications for the interpretation of equation (3). If a household does not update its priors about the public signal every period, then the effects of public information depend on the probability (denoted as \( h \in [0,1] \)) that a given household actually updates its prior using the public information available in that period and the magnitude of the public signal.20

Assuming that the expectation function can be approximated by a linear conditional expectation function, we have the following specification (to simplify notation, assume that the information sets are singletons):

\[
E_i(X_{t+1}) = E_i(X_{t+1} | \Omega_{t(i)}, \Omega_{p(t)}, Z_i, e_i) = \gamma_0 + \gamma_1 h \Omega_{p(t)} + \gamma_2 \Omega_{t(i)} + Z_i \Pi + e_i \tag{4}
\]

Here \( \gamma_1 \equiv \alpha_i h \) shows the relevance of public information \( \Omega_{p(t)} \) for price expectations, and identification and estimation of this parameter (i.e., \( \gamma_1 \)) is the focus of this paper. Given our previous discussion, it is clear that \( \gamma_1 \) measures the net result of the likelihood that public information is collected in a given period by the household and, conditional on acquiring public information, the influence it exerts on the formation of expectations, which depends primarily on the precision (information content) of the public information relative to the private information (Amador & Weill, 2008). If we take the readily available data on published inflation statistics in a country as the measure of the public signal and estimate equation (4), the coefficient on the public signal will be biased, as it is not possible to

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20 One might wonder if we should expect \( h \) to be higher or lower in a developing country. Do Ecuadorian households pay more attention to public price information compared to households in a developed country? We thank an anonymous referee for raising this point. Unfortunately, the theory cannot resolve this issue as there are arguments on both sides. On the one hand, there is a presumption that households in developed countries pay more attention to public signals because they have more access to information (richness of information channels). But on the other hand, there are too many information bits competing for the limited attention span of a human being in developed countries, a point emphasized by, Falkinger (2008). The resulting crowding out of price information tends to reduce the probability that households in developed countries pay close attention to public price information (they may be more tuned to celebrity news and watching shows on 500 TV channels, for example).
control for the private information set, a point discussed before.

The model in equation (4) is, however, restrictive in that it imposes a homogeneity restriction on the conditional response of agents to public information. Public information may have heterogeneous effects on price expectations for a variety of reasons. First, an agent’s demographic characteristics such as age, gender, and education may affect the strength of the influence of public signal because such variables can be measures of differences in access to information channels and also in cognitive skills needed to process public signals. Moreover, notice that $\Omega_{m(t)}$ provides information about prices of a fixed basket of goods and services. Because households have heterogeneous consumption patterns and shopping habits, the relevance of the common public signal is also likely to be heterogeneous (for an interesting discussion on heterogeneity in inflation expectations, see Jonung, 1981; Batchelor & Jonung, 1986; Bryan & Venkatu, 2001a, 2001b; Branch, 2004; Souleles, 2004; Blachflower & MacCoille, 2009). For example, if a household does most of its shopping in a market not covered by the CPI (such as black market), the public signal will be less important.21

To perform a direct test of the implications of different shopping and consumption patterns, one would ideally like to work with group-specific price indices, including price information from the black and gray markets. But unfortunately, such information is not available in most of the countries.22 Given the data constraints, we introduce heterogeneity in the effects of public information by including its interactions with the household head’s characteristics like age, education, and gender and also with household income.

21 In the context of our paper, a household’s informal transactions or transactions in the black market represent part of the private information. Some of these transactions would involve goods and services not covered by the CPI. The larger is this lack of overlap between the CPI basket and the actual transactions of a household, the weaker we would expect the effect of public information to be. Thus, the effects of public information (CPI) for a household that regularly shops in these markets is likely to be weaker. However, we believe that for most of the households in our sample, the basket of goods and services included in the CPI and their actual consumption basket have a large intersection set, and thus the CPI is relevant and provides an important source of information. The households we focus on are urban households that, unlike farming ones, buy food from the market, which enjoys the most weight in both CPI and household budget. Moreover, black markets in Ecuador were rare (except for illegal drugs) at the time of the survey used in this study. Also, the prices of many goods traded in the informal sector (such as agricultural products) are surveyed by the INEC and are included in the CPI.

22 Because we use a single CPI index as the measure of public information for all households, we need to interpret the results carefully. In particular, we cannot say anything about specific household prices and inflation. However, we believe that given our focus on estimating the importance of public price information in household expectations, it is appropriate to focus on the city-specific CPI because this is the most disaggregated level CPI published by INEC; no group-specific CPI indices are available from INEC or any other public agencies. In fact, there is no group-specific public price information published by the central statistical agencies in most of the developed countries. The different components of the CPI are also not readily available to households. Even in the United States, the group-specific CPIs were not available until recently. McGrawanah and Paulson (2005) provided the first group-specific CPI estimates.

The general model of expectation can thus be written as

$$E_{i(t)}(X_{t+1}) = \gamma_0 + \gamma_1 \Omega_{p(t)} + (\Omega_{p(t)} + H_1) \Gamma + \gamma_2 \Omega_{i(t)} + Z_i \Pi + \epsilon_t,$$  

(5)

where $H_i \subseteq Z_i$ is a vector of relevant characteristics of agent $i$ such as age, gender, and education that might influence the impact of the public signal. A better-educated individual is expected to be more responsive to the public signals because of better access to information channels and improved cognitive ability, among other things. Age might play a role, as older people may be more budget conscious and worry about prices more given a flat or declining earnings profile. They might also respond more to the public signal as the demands on their attention might be less when they are not active in the labor market. The gender difference in the effect of public signal may be due to differences in exposure to the media and differences in the precision of private information sets. Women usually do the daily shopping at grocery and department stores and thus are likely to have more market interactions than men. This means that women tend to have more precise information about price trends in their own neighborhood and may rely more on the private information set when forming price expectations. Household income might determine the information channels available (such as television and radio) and thus affect the likelihood that the public signal reaches a given household.23

B. Econometric Strategy

The source of the error in the INEC’s estimates of CPI and inflation rate over the fourteen-month period is a random mistake in the computer software used to calculate the CPI. We use this “natural experiment” as the source of data variations to identify the effects of public information about prices on the price expectations of households. To identify the causal effect of public price information, we use a three-pronged strategy. First, we measure the public signal as the part of incorrect inflation that is due to the programming error (the gap between the incorrect and revised inflation rates).24 Second, we add the revised inflation rate (published in April 2006) in the city of residence of a household as a control for the correlated private information in our empirical models. The revised inflation rate was unobservable to households during the fourteen months when INEC had been publishing incorrect estimates. Thus, the revised (and unobserved at the time) inflation can affect price expectations only if it works

23 The data set does not contain information on ownership of television and radio. However, we believe that household income and education are reliable controls for such heterogeneity in information channels. Also, note that it is unlikely that the ownership of television and radio would change significantly in a period of fourteen months.

24 Note that the inflation rate rather than the CPI is the relevant public signal for formed expectations regarding future prices. The public release of price statistics and media reports concentrates mostly on the inflation rate, and thus household’s price perceptions are likely to respond to the published inflation rates.
as a proxy variable for the private information set.\textsuperscript{25} It is extremely difficult, if not impossible, to get appropriate data on private information gathered by the households through their market and social interactions. The local prices on the items covered in the CPI basket such as food, clothing, and housing would be correlated with the corresponding components of the revised CPI at the city level (unobserved at the time). Once we control for the unobserved revised inflation estimate, this takes care of the potential omitted variables bias as it effectively captures such correlated private information. Third, all of the empirical models in this paper include city and time (month) fixed effects. The city fixed effects control for the differential but time-invariant component of the idiosyncratic information set available to the households in a given city, while the time (month) fixed effects sweep off the effects of any macroeconomic news common to the cities that might influence the expectations of the households. One can also appeal to the voluminous literature on the Phillips curve to argue that a household’s price expectations and the labor market conditions are closely related. For identification of the effects of public price signal on household price expectations, we thus need to control for public signals on the labor market conditions, in particular, the unemployment rate. To alleviate such concerns, we include the city-level monthly unemployment rate as an additional control in the regressions. The upshot of the discussion is that, conditional on the unobserved revised inflation rate, city and month fixed effects, and city-level unemployment rate, the difference between the incorrect and the revised inflation rates can be treated as a valid natural experiment for identifying the effects of public information on households’ price expectations. If the public price signal does not matter for a household’s price expectations, then the mistake itself should not affect the household’s expectations after controlling for the vector of variables mentioned above.

To test this hypothesis, we use a simple empirical model based on equation (5). As is common with the survey data on price expectations, our data set from three cities in Ecuador provides us information about the direction of price expectations. More precisely, the survey allows us to use a binary variable, which takes on the value of 1 when a household thinks that the prices will go up in the next twelve months. Given the binary nature of the price expectation variable, we use a probit model:\textsuperscript{26}

\begin{equation}
E(P_{ic(t+1)}) = \Phi\left(\beta_0 + \beta_1 \tilde{P}_{ic(t)} + \left(\tilde{P}_{ic(t)} * H_i \right) Y + \beta_2 U_{ic(t)} + \beta_3 Z_i \Pi \right),
\end{equation}

where $P_{ic(t+1)}$ is a binary price expectation variable that takes on a value of 1 if the household $i$ in city $c$ surveyed in month $t$ expects that the prices will go up in next twelve months, $\tilde{P}_{ic(t)}$ is the gap between the incorrect and revised inflation rate available to the household at period $t$, $\tilde{P}_{ic(t)}$ is the revised inflation rate, $Z_i$ is a vector of household characteristics, and $H_i \subseteq Z_i$ is the subset of household characteristics that might influence the strength of the public signal’s impact. Our focus is on the identification and estimation of the parameters $\beta_1$ and $Y$. One can argue that the model in equation (6) is still parsimonious in the sense that the public and private information sets include only the latest information available at period $t$ on the relevant variables. In a more general model, additional information from past periods may be relevant in forming household price expectations. For example, in addition to the most recent published inflation rate, the magnitude of the change in inflation rate between the last two periods may be important for the determination of expectations.\textsuperscript{27} In the empirical analysis, we explore this possibility and check the robustness of the conclusions reached on the basis of the parsimonious specification in equation (6).

IV. The Data and Variables

To estimate equation (6), we use data from a monthly survey that the Central Bank of Ecuador has used to produce consumer confidence indices and unemployment statistics.\textsuperscript{28} The survey was financed by the Central Bank and carried out by the Facultad de Ciencias Sociales FLACSO–Ecuador, a leading university in the country. It is representative of the population of Quito, Guayaquil, and Cuenca, Ecuador’s three largest urban centers.

The sample consists of a rotating panel of more than 3,000 households (dwellings). However, the individual identifiers are not available, and we are not able to exploit the panel nature of the data. Each month, about 2,300 of these households are interviewed, and information about employment, earnings, and basic demographic characteristics (such as education and marital status, for example) for each member of the family is collected. In addition, the respondent is asked twenty questions about her well-being and her perceptions about the economic prospects of the country. The following question regarding price expectations forms the basis of our analysis: “Within the next 12 months, do you think that prices will increase, decrease, or stay the same?” As noted earlier, we created a dummy variable that equals 1 when a household response to the question is that they think the prices will increase in the next twelve months.

\textsuperscript{25} It is important to appreciate that the revised unobserved inflation rate may have no impact on price expectations if the weight put by the household on private information is small. Omitted private information not correlated with the revised CPI does not bias the estimated effects of the published inflation on price expectations, although it, in general, affects the efficiency of the estimates.

\textsuperscript{26} In the empirical implementation, we also report results from linear probability model and logit model in the online appendix.

\textsuperscript{27} It is reasonable to assume that people pay more attention to the inflation rate when there is a relatively large change from one period to the next. Given the sample size, it is not possible to estimate a more general dynamic model.

\textsuperscript{28} The employment survey is used to compute a consumer confidence index (see, for example, Banco Central del Ecuador, 2007) and unemployment statistics (see, e.g., Banco Central del Ecuador, 2006, table 4.1.7).
The variable we use to measure price expectations has limitations. First, like many other developing countries, the price expectations data we have for Ecuadorian households relate to the direction of price change. We would surely prefer to use a quantitative measure, but such data are not available.\(^{29}\) Second, the survey questionnaire is not worded carefully enough, and it may appear that it is not clear to respondents whether the question refers to prices in general or to the prices of goods and services that they generally buy. However, from our discussions with the Ecuadorian officials at the INEC and the Central Bank, we are confident that the question elicits meaningful responses in the sense that the households are most likely to interpret it as a question about the prices they face for the bundle of goods relevant for them.\(^{30}\) So the survey expectations are not to be interpreted as a household’s forecast of general CPI and inflation trend in the macroeconomy. Finally, notice that the survey question asks about changes in the level of prices; it is likely, however, that at least some of the households in our sample interpret it as a question about changes in inflation. For these reasons, the qualitative data we use for our analysis may have measurement error. Measurement error in the dependent variable may compromise the fit of the regression, but it does not affect adversely the identification and estimation of the causal effects of public information, the focus of our paper.

The survey data have been matched with inflation estimates from the INEC that vary by city and month. Both the incorrect and the revised estimates of inflation have been recorded. CPI and inflation official data about month \(t - 1\) (say, February) are released on the first day of month \(t\) (say, March). For this reason, survey data have been matched with inflation data from the previous month. For example, households surveyed in March 2006 have been matched with inflation data for February 2006. Our public signal measure (inflation) has limitations. As we discussed earlier, official inflation data provide the same public signal (inflation) to all households in a region (recall that there are no group-specific price indices available). Because households have heterogeneous consumption patterns, the public signal is likely to be more relevant for households whose shopping habits are best captured by the CPI basket. In addition, if the CPI basket excludes goods from black markets or informal sectors that are relevant to the typical consumer, published inflation rates should be less relevant to consumers.\(^{31}\)

In addition, the data set provides information about the head of the household’s demographic characteristics such as gender, education, age, marital status, income, and number of children. A list and definition of the variables are presented in table 1. To estimate equation (6), we use survey data from April 2005 to March 2006, the period when the incorrect public signal was released.\(^{32}\)

Descriptive statistics are shown in table 2. The incorrect average annual inflation rate in Quito, Guayaquil, and Cuenca published in March 2006 was close to 4.7% and dropped to 3.1% once the error was accounted for.\(^{33}\) As shown in figure 6, there are substantial variations in both the revised and incorrect inflation estimates in each of these cities. The typical household was headed by a 47-year-old male with nine years of education. Household income averages about $330 per month, although income distribu-

\(^{29}\) One could use standard transformation methods, such as the Carlson-Parkin method (Carlson and Parkin, 1975), or recent modifications of it, to transform the qualitative answers into quantitative data. These techniques, however, generally rely on strong assumptions about an individual’s expectations formation. We thus chose not to follow this approach.

\(^{30}\) One of the authors grew up in Ecuador and has intimate knowledge of the language and its interpretation by a representative household.

\(^{31}\) We thank an anonymous referee for making us aware of the limitations of the CPI data.

\(^{32}\) INEC’s mistake started in January 2005. Unfortunately, we have survey data only from April 2005.

\(^{33}\) Notice that inflation rate estimates published in March 2006 refer to the inflation of February 2006. These numbers do not exactly match those displayed in figure 3 because they refer only to the three cities covered in the survey.

<table>
<thead>
<tr>
<th>Table 1.—Description of Variables</th>
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<tr>
<td>Variable</td>
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<tr>
<td>Future prices</td>
</tr>
<tr>
<td>Revised inflation</td>
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<tr>
<td>Incorrect inflation</td>
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<tr>
<td>Unemployment rate</td>
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<tr>
<td>Education</td>
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<tr>
<td>Male</td>
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<td>Age</td>
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<tr>
<td>Income</td>
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<tr>
<td>Children</td>
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<td>Partner</td>
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</table>

<table>
<thead>
<tr>
<th>Table 2.—Descriptive Statistics</th>
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<tbody>
<tr>
<td>Variable</td>
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</tr>
<tr>
<td>Future prices</td>
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<tr>
<td>Revised inflation</td>
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<td>Incorrect inflation</td>
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<td>Unemployment rate</td>
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<td>Income</td>
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<tr>
<td>Children</td>
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<tr>
<td>Partner</td>
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<tr>
<td>Observations</td>
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</tbody>
</table>
tion is clearly skewed to the right, with a handful of households earning more than $5,000 per month.

V. Empirical Results

A. Public Signal and Household Expectations about Price Changes

Table 3 reports the estimation results from the probit model (marginal effects evaluated at the sample means) based on equation (6). We report estimates from a number of alternative specifications. The first column of the table reports the simplest specification; then we progressively expand the set of controls. The results and conclusions of this paper are robust if we employ linear probability and logit models instead of the probit model. For brevity, we discuss the results only from the probit model in the text and report the results from linear probability and logit models in the online appendix.

If the public signal matters, then the mistake itself (i.e., incorrect inflation — revised inflation) should affect household’s expectations and a positive coefficient on the public signal ($\beta_1 > 0$). Specifications 1 to 4 in table 3 present robust evidence in favor of an important effect of public signal on households’ price expectations. Across all the specifications, the estimates show a consistently positive coefficient on the public signal ($\beta_1$). The magnitude of the coefficient seems robust, even after controlling for the revised inflation rate, unemployment rate, household’s demographic characteristics, and month and city fixed effects.34

### Table 3.—Regression Results: Marginal Effects of Probit Model, Evaluated at the Sample Means

<table>
<thead>
<tr>
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<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PubSig = (Incorrect inflation — Revised inflation)</td>
<td>0.0263</td>
<td>0.0315</td>
<td>0.0382</td>
<td>0.0347</td>
<td>-0.0023</td>
</tr>
<tr>
<td></td>
<td>(0.0083)***</td>
<td>(0.0090)***</td>
<td>(0.0091)***</td>
<td>(0.0091)***</td>
<td>(0.0175)</td>
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<td></td>
<td>[0.0166]</td>
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<td>[0.0153]</td>
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<td>[0.0188]</td>
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<td>-0.0152</td>
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<tr>
<td></td>
<td>(0.0053)</td>
<td>(0.0055)***</td>
<td>(0.0055)***</td>
<td>(0.0055)***</td>
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<tr>
<td></td>
<td>[0.0114]</td>
<td>[0.0111]</td>
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<td></td>
</tr>
<tr>
<td>Revised Inflation</td>
<td>0.0365</td>
<td>0.0379</td>
<td>0.0394</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.0065)***</td>
<td>(0.0065)***</td>
<td>(0.0065)***</td>
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</tr>
<tr>
<td></td>
<td>[0.0113]***</td>
<td>[0.0112]***</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>PubSig x Education</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.0021</td>
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<td></td>
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<td></td>
<td></td>
<td>(0.0005)***</td>
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<td></td>
<td></td>
<td></td>
<td>[0.0009]**</td>
</tr>
<tr>
<td>PubSig x Male</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.0188</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(0.0075)**</td>
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<td></td>
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<td></td>
<td></td>
<td>[0.0115]</td>
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<tr>
<td>PubSig x Age</td>
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<td></td>
<td></td>
<td>0.0004</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(0.0002)*</td>
</tr>
<tr>
<td>PubSig x Log Income</td>
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<td></td>
<td></td>
<td></td>
<td>-0.0024</td>
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<tr>
<td></td>
<td></td>
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<td>(0.0015)</td>
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<td></td>
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<td></td>
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<td>[0.0025]</td>
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<tr>
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<td>-0.0013</td>
<td>-0.0022</td>
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<td></td>
<td></td>
<td>(0.0004)***</td>
<td>(0.0005)***</td>
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<tr>
<td></td>
<td></td>
<td>[0.0007]*</td>
<td>[0.0008]***</td>
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<tr>
<td>Male</td>
<td></td>
<td>0.0145</td>
<td>0.0046</td>
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<td></td>
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<td>(0.0057)***</td>
<td>(0.0068)</td>
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<tr>
<td></td>
<td></td>
<td>[0.0083]*</td>
<td>[0.0067]</td>
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<tr>
<td>Age</td>
<td></td>
<td>0.0006</td>
<td>0.0004</td>
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<tr>
<td></td>
<td></td>
<td>(0.0002)***</td>
<td>(0.0002)**</td>
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<tr>
<td></td>
<td></td>
<td>[0.0002]**</td>
<td>[0.0002]**</td>
<td></td>
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</tr>
<tr>
<td>Log Income</td>
<td></td>
<td>-0.0072</td>
<td>-0.0058</td>
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<tr>
<td></td>
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<td>(0.0011)***</td>
<td>(0.0014)***</td>
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<tr>
<td></td>
<td></td>
<td>[0.0024]**</td>
<td>[0.0027]**</td>
<td></td>
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<tr>
<td>Children</td>
<td></td>
<td>0.0060</td>
<td>0.0061</td>
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<td></td>
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<tr>
<td></td>
<td></td>
<td>(0.0036)</td>
<td>(0.0036)*</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>[0.0031]***</td>
<td>[0.0031]***</td>
<td></td>
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</tr>
<tr>
<td>Partner</td>
<td></td>
<td>-0.0385</td>
<td>-0.0378</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>(0.0069)***</td>
<td>(0.0069)***</td>
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<tr>
<td></td>
<td></td>
<td>[0.0087]***</td>
<td>[0.0085]***</td>
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</tbody>
</table>

Dependent variable equals 1 if household thinks that prices will increase within the next twelve months. We use survey data from April 2005 to March 2006, and the total number of observations is 28,463. All models include month and city fixed effects. Standard errors robust to heteroskedasticity are in parentheses. Standard errors clustered at the city-month level (and robust to heteroskedasticity) are shown in brackets. *, **, and *** denote significance at the 10%, 5%, and 1% level, respectively.

34 Notice that month fixed effects wipe out all strictly time-series variations common to the cities in the dependent variable (our survey spans only twelve months). We thus exploit city-specific variations to identify our key parameter. The fact that we find a positive impact of public information about inflation on household price expectations suggests that Ecuadorians pay attention to city-specific inflation rates. This is not surprising given that the city-level price information is as widely advertised as the national CPI. Presumably aggregate national price data are relevant for individuals because official CPI statistics at the national level are used to compute price adjustments in any related legal matter in the country. City-specific price data are relevant for forming an individual’s inflation perceptions and price expectations given the heterogeneity of prices across locations. Our study cannot assess the importance of national-level public price signals relative to city-level signals. Our results suggest, however, that the city-level price data released by the government are relevant for households’ price expectations.
The estimated effect of the public signal is statistically significant at the 1% level across specifications 1 to 4 according to the robust standard errors reported in parentheses below the coefficient. However, when we take into account possible cluster correlations at the city-month level in addition to heteroskedasticity, the standard errors become larger, which is consistent with a priori expectations (reported in brackets under the coefficient and referred to as clustered standard errors henceforth). It is reassuring that the estimated effects of the public signal in the more general specifications, 3 and 4, remain significant at the 5% level even after correcting for possible cluster correlations. The estimated effects of public signal are not small. For instance, using the specification in column 4, our estimates imply that an “incorrect” INEC estimate that overpredicts the revised inflation rate by 3 percentage points increases the share of households that expect prices to increase by about 10 percentage points. The relevance of the public signal depends primarily on its precision (information content) relative to that of the private signals (Amador & Weill, 2008). Thus, our results suggest that even in a developing country, an institute such as the INEC that enjoys a measure of credibility (see the discussion in section II.B) can provide valuable public information and help aggregate dispersed information.

An interesting finding from table 3 is that the revised inflation rate has a statistically significant (at the 1% level according to the clustered standard errors) effect on price expectations. This is consistent with the conclusion that the unobserved revised inflation rate is a good control for the correlated private information of the households. Also, consistent with the available evidence, the unemployment rate has a negative correlation with the price expectations of the households, although it is not statistically significant.

In addition, the results suggest that the future price expectations depend on the demographic characteristics of the household. For example, estimates displayed in column 4 of table 3 show that a household headed by a male is about 1.5 percentage points more likely to think that prices will increase than would a household headed by a female. This is in contrast to the available evidence in the context of the United States that women usually predict higher inflation rates than men do (Bryan & Venkatu, 2001a). There is, however, some recent evidence in the context of the United Kingdom that men hold higher inflation expectations (Blanchflower & MacCoille, 2009). Moreover, the older the head of the household, the higher is the probability that he or she expects future prices to increase, and households with higher income expect lower prices; these findings are consistent with the evidence on developed countries (Bryan & Venkatu, 2001a, Blanchflower & MacCoille, 2009).

The last column of table 3 reports the results from the general specification in equation (6) that allows for heterogeneity in the effects of public information. This heterogeneity is modeled by interaction terms between the public signal and the household head’s characteristics (education, gender, and age) and log household income. The results provide evidence that the effects of public price information are heterogeneous; they vary substantially with the household characteristics. The results suggest that the public signal has a stronger effect among those who are more educated (p-value 0.015 according to clustered standard error). The age of the household head also has a positive effect on the impact of the public signal, although the numerical magnitude of this effect is relatively small, and it is also less precisely estimated (p-value 0.084 according to the clustered standard error and 0.077 according to the robust standard error). The estimates also indicate a numerically important gender difference in the effects of public signal, and it is statistically significant at the 1% level if one relies on the robust standard error. According to the clustered standard error, the estimated gender difference is not statistically significant. If households with higher income expect lower prices, these are also the salient items in its market transactions; especially food and clothing dominate their daily market interactions. In Ecuador from 2003, the CPI basket covers 299 goods and services. It is thus only natural that the correlation between the revised CPI and private information is likely to be strong. This also means that if one finds the coefficient on the true inflation rate not significant, the most likely reason is that correlated private information does not play any significant role in price expectations.

The evidence in the literature on developed countries is that demographic characteristics, especially gender, education, and income, affect inflation expectations formation significantly. See, for example, Jonung (1981), Batchelor and Jonung (1986), Bryan and Venkatu (2001a, 2001b), Pfajfar and Santoro (2008), Blanchflower and Kelly (2008), and Blanchflower and MacCoille (2009).

Although this finding is not very robust and depends on the survey used.

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35 Since we include the city fixed effects in the estimation, it sweeps off any time-invariant source of intracity correlations among the households. We also employ month fixed effects, and thus serial correlation in inflation is not likely to be a problem. Also, if we use aggregate data at the city level to estimate the basic model, the central conclusion that the public signal has a statistically significant and economically important impact on household price expectations remains intact. Note that the city-level aggregation cannot be used when we relax the restrictive assumption of no heterogeneity in the effects of public signal.

36 The percentage of people expecting an increase in future prices would go up from about 79% to 89%.

37 Ecuador faced periods of high inflation in the past, and thus, price trends are a topic of general concern. This might lead one to think that our results are relevant only for countries where inflation had been a problem historically. However, we believe that the results are of more general interest. In fact, one can argue that the role of periodically published price information (such as monthly inflation rate) has little value in a high-inflation environment. In an environment of rapidly rising prices, households would rely more on private information generated by their daily market interactions. Thus, periodically published public price signals influence household price expectations more in a relatively stable inflation regime, as has been the case in Ecuador in recent years. We are also keenly aware of the limitations of our study when it comes to generalization of the results. Clearly the results from Ecuador are likely to be more informative only for other similar countries. For example, if the statistical agency in a country does not have a certain amount of credibility as enjoyed by INEC in Ecuador, the estimated effects of public price information would probably be smaller.

38 The revised CPI would be correlated with the private price information on the items covered in the CPI basket. In most countries, the CPI basket is dominated by food, clothing, and housing. For a typical household, these are also the salient items in its market transactions; especially food and clothing dominate their daily market interactions. In Ecuador from 2003, the CPI basket covers 299 goods and services. It is thus only natural that the correlation between the revised CPI and private information is likely to be strong. This also means that if one finds the coefficient on the true inflation rate not significant, the most likely reason is that correlated private information does not play any significant role in price expectations.

39 The evidence in the literature on developed countries is that demographic characteristics, especially gender, education, and income, affect inflation expectations formation significantly. See, for example, Jonung (1981), Batchelor and Jonung (1986), Bryan and Venkatu (2001a, 2001b), Pfajfar and Santoro (2008), Blanchflower and Kelly (2008), and Blanchflower and MacCoille (2009).

40 Although this finding is not very robust and depends on the survey used.
tically significant at the 5% level; the \( p \)-value is equal to 0.10. One can make an argument that when estimating the interaction effects, there is no a priori reason to expect significant cluster correlations that arise from the fact that the variations in the inflation are at the city-month level. The data variations used for identifying the interaction effects are at the household level, even though the inflation rate varies only at the city-month level. In this sense, the robust standard errors reported in parentheses may be more appropriate for specification 5 in table 3.\textsuperscript{41}

After controlling for household characteristics through appropriate interaction effects, we do not find any evidence that household income matters for the impact of the public signal. The estimated coefficient on the public signal itself (the difference between the incorrect and revised inflation) becomes much smaller and statistically insignificant when the interaction effects are included. This implies that the effect of public price information is negligible for uneducated young women. The evidence (although imprecise) that a public signal has a weaker effect on the price expectations of women is consistent with the hypothesis that women tend to acquire more precise information about local price trends because they do most of the shopping for the typical household. To have a better sense of the magnitude of the interaction effects, consider a scenario where the government incorrectly overstates the inflation rate by 3 percentage points. In this case, the probability that a respondent thinks that prices will increase goes up by 0.14 when he or she has eighteen years of education. The corresponding number for an uneducated respondent is only 0.047. In terms of gender differences, the estimates imply that the impact of a 3 percentage point increase in the published inflation on the probability that a person expects prices to be higher is 0.11 and 0.06 for an average male and female, respectively. Uneducated young women, on the other hand, do not systematically change their opinions about future prices when the public signal changes.

### B. Robustness Checks

An important part of our identification strategy for the results in table 3 is that we use the revised inflation estimates (city level) that correct for the software error to control for the correlated prices that households face in their daily interactions. While we believe that this is an eminently sensible choice, there are other plausible alternatives. For example, one can argue that households care more about the prices of the products that they buy more often (such as food and energy) and less about other products that nonetheless are part of the CPI. If this is the case, the prices that households face in their market interactions could be better approximated by those of food-related products. One can also argue that the unobserved revised inflation (both for overall CPI and food CPI) for a single period may not capture all the relevant correlated private information (i.e., correlated with the public signal). To address this issue, we include the change in the revised inflation rates between the two most recent periods, in addition to the most recent revised inflation rate as a control for correlated private information. We explore these different possibilities in table 4. The results in panel A use the specification without the interaction effects (corresponding to column 4 in table 3) and those in panel B use the general specification including the interaction effects (corresponding to column 5 in table 3).

First, consider the results reported in panel A. The first column shows our baseline results that correspond to those displayed in the fourth column of table 3. To control for the prices that households face, in the second column, we use the revised (but unobserved) inflation rate of the food-and-beverage CPI group as a control for correlated private information. The coefficient of public signal is very similar to that in column 1 and remains statistically significant at the 5% level. The third column adds the change in the revised food CPI between the two recent periods to the specification in column 2. The fourth column reports the results when we add the change in revised inflation rates over the two recent periods, along with the revised inflation rate (based on the overall CPI). The evidence in columns 3 and 4 of A clearly shows that the strong effect of the public signal on households’ price expectations is robust to these alternative specifications.

In the specifications discussed so far (table 3 and first four columns of panel A of table 4), we use the difference between the incorrect and revised inflation rates as the relevant public signal available in period \( t \). One might worry that by focusing on a single period’s public information, we are potentially underestimating the effect of the public signal. The households are likely to take into account public information from more than just the recent past period. To address this issue, the last two columns in panel A of table 4 report the estimated effect of the public price signal when we include the change in the public signal over the two most recent periods, along with the public signal (in level) at period \( t \) in alternative specifications. The magnitude of change in the public signal would be important in expectation formation if households learn over time and also pay attention to the public signal more when there is a large change from one period to the next. The results are consistent with the conclusion that the public signal has a significant effect on the formation of price expectations of the households. Consider, for example, the most general specification in column 6. The coefficient of the public signal at period \( t \) is smaller and less precisely estimated in this specification, but the change in public signal over the recent two periods has a coefficient similar to that of public signal at \( t \) in column 4 of panel A, and it is significant at 10% according to the clustered standard error (at 1% if we rely on robust standard errors).

Panel B of table 4 shows evidence on the heterogeneity in the effects of the public signal using the alternative con-

\textsuperscript{41} We thank Jeffrey Wooldridge for clarifications on this point.
trols for private information set discussed above and also different measures of the public signal. The estimated interaction effects are robust and consistent with the results reported in table 3 and discussed in the preceding section.

C. Economic Significance of the Effects of Public Information

In the previous sections, we presented robust evidence that public information about prices affects households’ price expectations: the effects are large in magnitude and statistically significant. A natural question to ask at this point is: Does public price information affect household expectations in a way that has important consequences for the economy? In other words, is the impact of public signal on households’ expectations economically as well as statistically significant? This is an important issue and deserves discussion.

The issue of economic significance in the context of our analysis has three aspects: (a) the magnitude of the change in the public price signal due to the software error, (b) the analysis has three aspects: (a) the magnitude of the change in the public price signal due to the software error, (b) the magnitude of the change in the public price signal due to the software error, and (c) the strength of the effects of public price information on the
expectations of households, and (c) the implications of the change in household’s price expectations arising from the public information for its behavior.

Magnitude of the error. The 1.5 percentage point difference between the announced and revised inflation series may at first seem small, especially in absolute terms. Notice, however, that given the low levels of inflation that were prevalent around that time (revised inflation rate of 3.8%), the “incorrect” inflation was overestimated by about 40% because of the programming error. This is not small in terms of magnitude. This is especially important because the inflation statistics have never been revised in Ecuador before. Whether this error actually influenced the expectations and behavior of individuals is the empirical question we investigate in this paper.

Strength of the effects of public information on expectations. The magnitude of estimated causal effect of public price information on a household’s price expectations is not small; a 1 percentage point increase in public signal increases the probability that a household changes its expectation of prices by 3 to 5 percentage points, depending on the specification used. An alternative way to think about it is that a 1 percentage point increase in the inflation estimate published by INEC causes 3% to 5% more households to change their price expectations from “a decline or no change” to “an increase.” In our data set, only about 20% of households can potentially change their expectations in a given period and say that they now expect prices to go up. Out of this 20%, 3% to 5% change their expectations when the announced inflation goes up by 1 percentage point because of the software error. This implies that about one-fifth of the households that could potentially change their expectations are actually influenced by a 1 percentage point increase in the public price signal, a substantial effect.

Effects on behavior: evidence from household savings. Public information about prices may affect households’ price expectations, but does it affect their economic behavior in a significant way? To explore this question, we analyze the relationship between households’ price expectations and their savings. If prices are expected to increase in the future, households should, ceteris paribus, substitute future spending in favor of current spending. Thus, on a priori grounds, we expect a negative (positive) relationship between current savings (spending) and future expected prices.

Although our data do not have detailed information about households’ spending patterns, they contain useful information about their savings. In particular, respondents were asked the following question: “During the past month, what were your household’s monthly savings?” Answers to this question were recorded in categorical form: (a) zero, (b) from $0 to $100, (c) from $100 to $500, and (d) more than $500. To analyze the determinants of the household’s savings, we transformed these categorical responses into numerical values and estimated a simple linear model.42

The model is estimated using OLS. The dependent variable is the household’s monthly savings. Covariates include household income and demographic characteristics, month fixed effects, city fixed effects, price levels (revised CPI), and the predicted probability that the respondent expects prices to increase within the next year (Predicted Prices). To compute this variable, we use the model in table 3, column 5 to calculate the likelihood that each individual from our sample expects prices to increase within the next year.43 Results are shown in the first column of table 5. Notice first that most of the coefficients have the expected signs. For example, monthly savings increase with income and education. The coefficient on our variable of interest (predicted prices) suggests that, as expected, there is a negative relationship between future expected prices and current savings: if the probability that a household expects prices to increase is 10 percentage points higher, on average, its savings decrease by $8.90. This relationship is statistically significant, even when standard errors are clustered at the city-month level.44 As a robustness check, table 5 also shows results from an alternative specification where the determinants of real rather than nominal savings are estimated. Results are barely affected when this specification is used.

We already estimated the effects of a public signal on future price expectations. For instance, our results from table 3 suggest that if the government announces an incorrect measure of inflation that is 1.4 times higher than the correctly computed one (i.e., a reported inflation of 5.3% instead of the revised estimate of 3.8%), the share of households that expect prices to increase goes up by about 5 percentage points (0.035 × [5.3 – 3.8] = 0.053). We can now combine the estimates in tables 3 and 5 to assess the effects of such changes on household’s savings. For instance, when the share of households that expect prices to increase goes up by about 0.053, average household savings decreases by $4.60 per month (5.3 × $0.89 = $4.60). We estimate that the average household in our sample has a monthly savings capacity of about $65.45 Hence, the incorrect signal (an absolute difference of 1.5 percentage points, which overes-

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42 For each of the categories, we assume the following numerical values: $0, $50, $300, and $750. Then we use OLS to estimate a linear regression model. This approach has been taken for its simplicity, but results are similar if nonlinear categorical models (such as ordered probit) are used.

43 Notice that the variable Predicted Prices is estimated in a first stage. Here, the variable PubSig (the difference between the incorrect and revised inflation rate) and its interactions with the individual demographic characteristics are used as exclusion restrictions to identify how price expectations affect savings in the second stage (table 5).

44 Because the variable Predicted Prices has been estimated in a first stage, standard errors have been adjusted accordingly.

45 Using national accounting publications from the Ecuadorian Central Bank, we estimate that the average propensity to save was close to 0.2 in Ecuador during 2006. Hence, the average household in our sample saves $328 × 0.2 = $65 per month.
estimated inflation rates by about 40%) is translated into a decline in household’s savings of about 7%. In table 6, we compute a similar exercise using different scenarios for the changes in the public signal, as well as alternative assumptions for the marginal propensity to save. In all cases, changes in the announced inflation rate seem to produce significant declines in household savings, suggesting that the public signal has a large and important economic effect.

VI. Conclusion

This paper provides credible evidence that public price signals provided by the government agencies can have a significant effect on household price expectations and that this effect is heterogeneous across households. To estimate the effect of the public price information on household price expectations, we exploit a natural experiment in Ecuador where, due to an error in the software used to compute the CPI, the published inflation rate from January 2005 to March 2006 deviated significantly from the revised inflation rate that corrected for the software error. We exploit the variations produced by the software error and the consequent release of the revised inflation series to identify the causal effect of the public price signal (published inflation rate) on the price expectations of the households. Innovative use of this interesting natural experiment to solve a difficult identification problem is one of the main contributions of this paper. Without the random software error, we would not be able to identify the effects of public information, as the published CPI is correlated with the private price information acquired by households through market and social interactions. The fact that the revised inflation rate was unobserved by the households at the time the incorrect inflation rate was being published allows us to use it as an excellent control for the correlated private information set.

We analyze the relationship between a household’s price expectations and the public price signal defined as that part of the observed inflation due to the programming error (i.e., the difference between the incorrect and revised inflation). Our results show that even after controlling for the revised

**Table 5. Effects of Expected Future Prices on Savings**

<table>
<thead>
<tr>
<th>Dependent Variable</th>
<th>Household’s Savings ($ per month)</th>
<th>Household’s Real Savings ($ 2004 per month)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coefficient</td>
<td>s.e.</td>
<td>Coefficient</td>
</tr>
<tr>
<td>Predicted prices: Probability household expect prices to increase (%)</td>
<td>-0.89 (0.34)***</td>
<td>[0.40]**</td>
</tr>
<tr>
<td>CPI (correctly measured)</td>
<td>-0.74 (1.47)</td>
<td>[2.17]</td>
</tr>
<tr>
<td>Unemployment rate</td>
<td>0.59 (1.28)</td>
<td>[1.64]</td>
</tr>
<tr>
<td>Education</td>
<td>2.71 (0.11)***</td>
<td>[0.16]**</td>
</tr>
<tr>
<td>Male</td>
<td>7.82 (1.22)***</td>
<td>[1.21]**</td>
</tr>
<tr>
<td>Age</td>
<td>0.24 (0.04)***</td>
<td>[0.04]**</td>
</tr>
<tr>
<td>Log Income</td>
<td>2.18 (0.38)***</td>
<td>[0.65]**</td>
</tr>
<tr>
<td>Children</td>
<td>-0.72 (0.72)</td>
<td>[0.80]</td>
</tr>
<tr>
<td>Partner</td>
<td>-6.27 (1.77)***</td>
<td>[2.19]**</td>
</tr>
<tr>
<td>Constant</td>
<td>98.97 (126)</td>
<td>[195]</td>
</tr>
<tr>
<td>( R_s )</td>
<td>0.072</td>
<td>0.071</td>
</tr>
</tbody>
</table>

The table shows OLS coefficients of a linear regression model. In both specifications, we use survey data from April 2005 to March 2006, the total number of observations is 28,453. Besides covariates on the table, models include month fixed effects and city fixed effects. The covariate “Predicted Prices” is the predicted probability that the respondent thinks prices will increase as predicted by the model in table 3, column 5. Because the variable Predicted Prices has been estimated in a first stage, standard errors have been adjusted accordingly. Standard errors robust to heteroskedasticity are in parentheses. Standard errors clustered at the city-month level (and robust to heteroskedasticity) are shown inside brackets. *, **, and ***, denote significance at the 10%, 5%, and 1% level, respectively.

**Table 6. Effects of Public Signal on Savings**

<table>
<thead>
<tr>
<th>Variation Public Signal (Announced Inflation Rate)</th>
<th>Changes in Savings (%) When Average Propensity to Save (s) is</th>
</tr>
</thead>
<tbody>
<tr>
<td>Absolute: Percentage Points</td>
<td>Relative: 100 x (Absolute/Level)</td>
</tr>
<tr>
<td>0.5</td>
<td>13.2</td>
</tr>
<tr>
<td>1.0</td>
<td>26.3</td>
</tr>
<tr>
<td>1.5</td>
<td>39.5</td>
</tr>
</tbody>
</table>

The table shows the effects of changes in the public signal (announced inflation rate) on average household’s savings (in percentage terms). To compute relative variations in announced inflation rates, we divide the absolute changes in the first column by the March 2006 revised annual inflation level of 3.8%. Baseline savings levels are estimated using the average household income of $328 per month and assumptions about the average propensity to save shown above.
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(unobserved at the time) inflation rate, household characteristics, and time and city fixed effects, the public price signal has a statistically significant and economically important effect on households’ price expectations. The impact of the public information is greater among more educated individuals and older people. There is also some evidence of a gender effect: the price expectations of men seem to be more influenced by the public information. The price expectations of young and uneducated women are not systematically influenced by the public information. Our estimates also suggest that the public price information affects a household’s savings decisions through its effects on the price expectations.

REFERENCES


