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Optimal Bidding in the Mexican Treasury Securities Primary Auctions: Results of a Structural Econometric Approach*

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This analysis of the Mexican Treasury securities primary auctions suggests that the uniform format yields higher revenues than the discriminatory format. It applies the structural econometric model proposed by Février, Préget, and Visser (2004). This model's main advantage is that it allows us to (i) estimate the parameters that characterize the distribution function of the securities'marginal value and the conditional distribution of the signals given the securities'value; (ii) derive optimal bids and equilibrium prices of alternative auction mechanisms; and (Hi) compare revenues. The uniform format's revenue superiority seems to be due to market uncertainty, defined as an environment with noisier value signals.

Keywords: Treasury Securities, Share Auction, Mexico.

El análisis de las subastas primarias de títulos de deuda pública del Gobierno Federal en México muestra la superioridad del formato de subasta uniforme respecto al discriminatorio, en términos de ingreso. El documento aplica el modelo econométrico estructural de Fevrier, Preget y Visser (2002). La principal ventaja del modelo es que permite construir posturas óptimas y precios de equilibrio en mecanismos de subasta alternativos y comparar los ingresos provenientes de cada uno. La superioridad del formato de subasta uniforme parece explicarse por el nivel de incertidumbre del mercado, definido como un ambiente donde la señal del valor es más ruidosa.

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1. INTRODUCTION

In this paper, we apply the structural econometric model of the share auction proposed by Février, Préget, and Visser (2004) -here after FPV- to analyze the Mexican Treasury securities primary auctions. Our motivation is twofold. On the one hand, we ought to mention that the intention to maximize the treasury's sales revenue is an important objective; however, due to the huge sums of money involved, the sales agencies are very sensitive to the need to avoid unnecessary responses to format changes that could drive investors out of the markets[1]. As a result, there have been hardly any "natural experiments" involving auction format switches up to now. The treasury securities markets' survey conducted by Bartolini and Cottarelli (1994) reported that within a sample of 77 countries only 7 of them -Belgium, Tanzania, France, Gambia, Italy, Mexico and the United States- had switched format, namely from the uniform to the discriminatory format. Furthermore, not many other format changes have occurred since then[2]. We think that this consideration favors the use of structural econometric models in order to compare auctions' revenue-generating properties, because they do not require to obtain results under different auction settings.

Our second motivation is that of comparing the findings of the structural model with those of the reduced form equations based on the results of "natural experiments" with a view to assess their consistency. The Mexican case readily lends itself for this purpose because there are two previous empirical studies using that technique. One of them is Umlauf (1993) -perhaps one of the best known auction studies- that analyzes the auctions of *Certificados de la Tesorería de la Federación* (CETES) carried out during the period 1986-1991. This study's best-known conclusion is that after Mexico instituted discriminatory auctions instead of uniform pricing auctions in 1989, bidders' profits decreased and seller's revenues increased accordingly. The other study is Laviada *et al.* (1997) who have reached the same conclusion in their analysis of the period 1995-1997, which covers the change back to the discriminatory auction format that took place in November of 1995. This is the auction format that has been used to sell the CETES since then (of course the problems of interpreting parameters obtained from reduced form equations, best summarized as the Lucas' critique, ought to be regarded as a severe warning against drawing conclusions on what policymakers should have done in the light of these two studies' results)[3].

Assessing consistency between the two methods may be useful because constructing structural theoretical models or estimating their empirical counterpart are not easy tasks. In what respects treasury securities auctions, the time lag existing between Robert Wilson's (1979) proposal of the share auction model and any empirical counterparts that we can estimate is a very good illustration of this. Therefore, reduced forms will remain in use as a first approximation to understand complex economic settings and integrate theory and econometrics in future structural models[4].

For our analysis, we estimate the FVP's structural econometric model, which is an empirical counterpart to Wilson's share auction model and which many authors consider a good theoretical approximation of the treasury securities auction's context[5]. We use a data set construed based on the public results of 180 CETES primary auctions carried out between January 2001 and April 2002, and published on Banco de Mexico's website. The data includes: (i) securities' characteristics, (ii) summary statistics of auctions, and (iii) anonymous distribution of prices and quantities of asked and allocated bids. As several other central banks publish auction results in the same fashion (given that they face similar restrictions in

what respects revealing bidders' identity and storing data), this approach may also be applicable in other cases.

Before briefly summarizing our results, let us point out one distinctive feature of the FPV model. Its statistical inference method relies on the Euler condition implied by the optimization problem of a bidder in a discriminatory price auction; so although we may assume that an equilibrium strategy exists and all bidders use it, it is not necessary to know the equilibrium's explicit form. However, the method requires a parametric framework to evaluate and compare the auctions' performance, with the advantage that this always enables us to rank auctions in terms of their revenue. In contrast, structural models that are distribution free and solve for the equilibrium bidding strategies usually require bidder-specific data (Armantier and Sbai, 2003; Hortacsu, 2002 and 2002a; Kang and Puller, 2007), which in turn is more difficult to obtain[6].

Our estimation results of the FPV model suggest, once again, that in Mexico the uniform price auction produces more revenues than the discriminatory price auction. Revenues from the CETES discriminatory auctions carried out during the period from January 2001 to April 2002 totaled 79,767.05 billion pesos. Contrasting with this, revenues from the corresponding hypothetical uniform auctions are 80,918.47 billion pesos. This difference in revenue is statistically significant. When we disaggregate the data by maturity, we also find that the discriminatory price auction yields higher revenues than the uniform price auction in the case of short term 28-day CETES, See, for example, Orellana *et al.* (2007).

while for the longer term -91,182 and 364-day CETES- the uniform price format yields the highest revenue. The revenue ranking runs counter to FPV's findings for French Treasury securities auctions (even though the two countries' auctions have several features in common), but coincides with the previous results for the 28-day CETES auctions obtained through the reduced equation technique.

To investigate whether the driving force behind the above-mentioned results relates to the type of bid shading that occurs in response to market uncertainty, we resort to four exercises that use the results of both the structural and reduced form estimations to greatest possible advantage. First, we compare the conditional variance of the value obtained in our exercise, which we can interpret as a higher degree of uncertainty in the good's value, as compared to the one obtained by FPV, and find that ours is considerably larger. Second, we look at the relationship between the gains of employing the uniform format and the volatility of the securities resale price for the 28-day CETES in our estimations, as well as in the results of Umlauf (1993) and Laviada *et al.* (1997) that cover different periods. We find that this relationship -that can also be ascribed to market uncertainty- is positive. Third, the cross maturity comparison of our estimations shows the same pattern. Fourth, a simulation re-estimating FPV's model using a value signal constructed with a higher variance (in effect, noisier) than the original data, shows that: (i) parameters obtained are consistent with the signals being less informative; and (ii) revenues obtained from the hypothetical uniform auctions exceed those from the observed discriminatory auctions by an even larger proportion than before. Thus, the four exercises point to market uncertainty having a role in the results.

The paper proceeds as follows: Section 2 describes the CETES auction framework and the dataset. Section 3, for the sake of completeness, presents Wilson's (1979) share auction model and the FPV (2004) estimation technique. Section 4 addresses the estimation results and the revenue comparisons between the discriminatory and the uniform format. Section 5 performs exercises to explore the possible impact of market uncertainty in the results. Finally, section 6 summarizes some conclusions and possible extensions.

2. A DESCRIPTION OF CETES' AUCTIONS AND DATA

The sales mechanism of the Mexican Treasury securities has been modified several times since the CETES were first issued in 1978. For purposes of our analysis, we focus our attention on the institutional framework that prevailed in our data period, which is between January 2001 and April 2002:

- Only brokerage houses, banks and investment funds based in Mexico can bid and acquire treasury securities[7].
- Optimal Bidding in the Mexican Treasury Securities Banco de México publishes on its website the primary auction announcement, after 12:00 a.m. of the last market day of the week immediately before the auction takes place[8,9]. It provides information as to the securities and auction's characteristics: securities' date of issue, announcement number, and issue's identification number, and auction format and maximum amount tendered.
- Primary auctions can be of either the uniform price or the discriminatory price format (the latter was the one in place during the period under study).
- Bidding for CETES is only through competitive bids, indicating the amount and discount rate at which the bidder is willing to buy the securities tendered[10]. Each bidder may submit one or more bids in the same auction. Bidders are to submit their bids no later than 13.30 p.m. on the second market day immediately before the securities' issue date. The sum of any bidder's quantity bids for any auction must not exceed 60% of the maximum amount tendered.
- All bids are obligatory and irreversible for the bidder. If a bidder does not pay for the securities allocated to him in full, Banco de México can cancel the sale for the unpaid securities amount. It can also ban the bidder from participating in subsequent auctions.
- The weighted allocation rate is determined based on the allocated bids. At any auction, the Treasury can determine the maximum discount rate at which it is willing to place the auction securities. Higher discount rates are not met in those cases (though, this right was not exercised in any of the auctions of the period under study)[11].
- Banco de México notifies the auctions' results to each bidder no later than 10:30 a.m. of the market day immediately after the auctions take place through the bank's service counter to meet account holders needs[12]. In addition, it announces the auctions' general results no later than 18:30 p.m. of the day of the auction through its website.
- The Security Safe Custody Institute delivers the securities allocated through each bidder's account[13] on the issue date. Brokerage houses and banks must pay for the securities through the institute's system. Other institutions must pay for the securities through a brokerage house or a bank.

Although the main CETES auction features agree in very broad terms with Wilson's (1979) share auction model and the statistical inference method of FPV, so we can assume that bidders are risk neutral, and the good on sale is divisible and has the same value for all bidders -in spite that it is unknown at the start of the auction-, there is one institutional feature of the CETES auctions that does not match those models. As in many security markets, after the primary auction there is a buy option for market makers that permits them to acquire more securities by placing non-competitive bids[14]. Actually, this mechanism is also in place for the French Treasury auctions analyzed by FPV. As a point in favor of this exercise, we can state that there are two aspects of the CETES auctions making them resemble Wilson's model much more than the French Treasury auctions. These

aspects are: i) CETES bidders at the primary auction are only allowed to submit competitive bids; and ii) the securities allocated through the market makers' buy option represent a much smaller proportion of the total number of securities' that are placed by the Mexican Treasury as compared to those placed by the French Treasury.

CETES are zero coupon bonds issued and liquidated by the Federal Government at the maturity date. Even today, they are among the most important public debt instruments of the Federal Government, with a high preponderance in the Mexican money and stock markets. The most common maturity dates have been 28, 91, 182 and 364 days. Our database derives from the general results of 180 CETES primary auctions that Banco de México publishes weekly at its website. The data includes (i) securities' characteristics, (ii) auction's summary statistics, and (iii) anonymous distribution of prices and quantities of both asked and allocated bids. During the period under study, 28 and 91-day CETES were auctioned weekly, 182-day CETES were auctioned every 2 weeks, and 364-day CETES every 4 weeks[15]. In turn, the source of the CETES secondary market prices is the price vector that Banco de México publishes on its website.

Table 1 shows the basic statistics of our dataset, involving 3,581 "differe nt" auction bidders that submitted 13,392 competitive bids totaling approximately 2,675,255 million pesos. Of these bids, 33.64% were allocated either totally or partially and 66.36% were rejected. The total amount of CETES issued by the Treasury is approximately 879,249 million pesos. Therefore, 93.65% of this amount was placed through competitive bids in the primary auction and only 6.35% was placed through market makers' non-competitive bids in the buy option. FPV report that these last two figures for the French Treasury securities are 91% and 8%, respectively (with the 1% residual placed through non-competitive bids received in the primary auctions). Hence, their argument that this amount of non-competitive bidding is too small to have an effect on the assumptions that support their estimation method can also hold in the case of the CETES auctions.

TABLE 1
OVERALL INFORMATION ABOUT THE AUCTIONS

	Number	Percentage (%)
CETES		
Number of Auctions	180	
28-day	65	36.11
91-day	65	36.11
182-day	33	18.33
364-day	17	9.45
Number of Bidders	3,581	
Number of Bids	13,393	
Allocated totally or partially	4,506	33.64
Not allocated	8,887	66.36
Total amount issued by the Treasury (in thousands of pesos)	879,249,141	
Non-competitive bids in the buy option for market makers	55,860,991	6.35
Competitive bids in the primary auction	823,388,150	93.65

Source: Author's own calculations based on public results of 180 CETES primary auctions carried out between January 2001 and April 2002.

Table 2 shows summary statistics per auction of the variables suggested by FPV for the empirical estimation. Statistics calculated for the whole sample are comparable to the French securities auction data as reported by the authors of the FPV model. The most obvious difference between the two samples relates to the securities' average maturity, which in Mexico is shorter than one year and in France is longer than 10 years. In general, the longer that the securities' maturity dates are, the higher the nominal yield is and the lower the secondary market price is. Therefore, for similar maturity dates, securities' secondary market prices seem to be higher in Mexico than in France. On the other hand, the variables for number of bidders, number of bids and cover (defined as the ratio of total amount of quantity bids to total amount issued by the Treasury), which measure the degree of auction competition, do not vary much across CETES with different maturity.

TABLE 2
CETES SUMMARY STATISTICS PER AUCTION
(January 2001-April 2002)

Statistic	Number of bidders	Number of bids	Amount issued by the Treasury (Thousands of pesos)	Secondary market price	Nominal yield*	Maturity of the security	Cover
All CETES							
Mean	19.46	73.92	4,538,043	96.84	10.30	109.18	3.24
Standard Deviation	6.13	19.59	674,815	3.14	3.48	94.22	0.90
Max	91	145	5,200,000	100	18.38	364	7.31
Min	12	35	3,300,000	84.81	5.26	27	1.68
Observations	180	180	180	180	180	180	180
28-day CETES							
Mean	18.90	72.12	4,500,000	99.30	9.13	28.00	3.02
Standard Deviation	2.70	16.54	0	0.25	3.07	0.28	0.81
Max	27.00	107.00	4,500,000	100.00	16.61	29.00	5.66
Min	15.00	42.00	4,500,000	98.74	5.65	27.00	1.70
Observations	65	65	65	65	65	65	65
91-day CETES							
Mean	19.63	78.71	5,200,000	97.62	9.74	91.00	3.60
Standard Deviation	3.41	18.68	0	0.78	2.93	0.28	0.87
Max	29.00	128.00	5,200,000	100.00	17.01	92.00	6.37
Min	13.00	35.00	5,200,000	95.80	5.92	90.00	2.32
Observations	65	65	65	65	65	65	65
182-day CETES							
Mean	18.61	68.86	3,300,000	94.91	10.59	178.96	3.38
Standard Deviation	3.11	20.39	0	1.41	2.75	5.83	1.17
Max	25.00	112.00	3,300,000	97.51	16.53	182.00	7.31
Min	13.00	40.00	3,300,000	92.11	6.49	168.00	1.78
Observations	33	33	33	33	33	33	33
364-day CETES							
Mean	19.00	78.00	4,646,154	89.16	11.20	348.77	3.02
Standard Deviation	3.34	27.70	161,325	2.12	2.18	14.52	0.97
Max	25.00	145.00	5,000,000	92.23	15.36	364.00	4.45
Min	14.00	43.00	4,500,000	85.61	8.34	335.00	1.68
Observations	17	17	17	17	17	17	17

Note: * Weighted allocation rate of the primary auction.
Source: Author's own calculations based on the public results of 180 CETES primary auctions carried out between January 2001 and April 2002.

Table 3 shows the summary statistics per bidder and per bid. In each auction, each bidder submitted four competitive bids on average; that is, four combinations of amount and discount rate at which they are willing to buy the securities. According to FPV, bidders in France and Portugal submit three bids on average, while in Turkey they submit seven bids on average. If a bidder distributes his individual demand into a larger number of bids as an optimal strategy to cope with market value uncertainty, these numbers suggest that the bidders participating in the Mexican auctions perceive a more uncertain environment than those participating in the French or Portuguese auctions, but less uncertain than those participating in the Turkish auctions[16].

TABLE 3
SUMMARY STATISTICS PER BIDDER OR PER BID IN THE CETES AUCTIONS

Variable	Mean	Standard Deviation	Maximum	Minimum	Observations
Number of bids per bidder	3.85	0.75	7.69	0.64	3,581
Demanded quantity per bidder (Thousands of pesos)	770,628	215,108	1,461,471	205,625	3,581
Demanded quantity per bid (Thousands of pesos)	204,300	61,088	418,286	116,342	13,393
Allocated bids per winning bidder	2.04	0.82	4.09	0.12	4,506
Allocated quantity per winning bidder (Thousands of pesos)	576,622	531,294	2,600,000	183,333	4,506
Allocated quantity per winning bid (Thousands of pesos)	432,918	571,619	2,600,000	64,706	4,506
Price bid	96.68	3.19	99.57	84.55	13,393
Highest price bid – Lowest price bid	0.38	0.42	2.58	0.04	13,393

Source: Author's own calculations based on the public results of 180 CETES primary auctions carried out between January 2001 and April 2002.

In turn, the average quantity bid per bidder is 770.63 million pesos, and the average winning number of bids per winning bidder is 576.62, so each winning bidder receives on average 74.82% of his quantity of bids. However, the rest of the data does not support this winning expectation. The mean and standard deviation of the demanded quantity per bid are 204.29 and 61.09, respectively, while those of the allocated quantity per winning bid are 432.92 and 571.62, respectively. Since these distributions of variables are truncated at zero, the latter statistics seem more consistent with a pattern of asymmetric information among the bidders[17]. Specifically, it would seem that bidders submitting large bids have more information about the good's value than bidders that submit small bids. Therefore, large bids win more often than small bids[18]. Although such asymmetry is not consistent with Wilson's model and we find it somewhat awkward, since we have no way of telling large from small bidders in our dataset we must assume symmetry for the rest of the analysis.

3. THEORETICAL MEDEL AND ECONOMETRIC TECHNIQUE

For the sake of completeness, this section briefly outlines Wilson's share model as presented in FPV along with the latter's econometric technique. However, readers are encouraged to refer to FPV's article for a more detailed discussion about the model's assumptions and properties[19]. Let us consider the auction of a perfectly divisible good among $n \geq 2$ risk neutral bidders. The good's value is the same for all bidders but unknown when the auction starts. We assume that the good's value follows a distribution function F_v (v) = Pr $(V <$ v). Before the auction, each bidder $i = 1,\ldots, n$ receives a private signal about the good's value. This signal is a realization of the random variable S_i. We assume signals $S_p \ldots, S_n$ to be independently and identically distributed given V.

The distribution of S_i given V is the same for all bidders and denoted as F_{SIv} (s I

v) = Pr (S_i,≤ s I V = v). The signal received by each bidder is observed only by him and not by either the seller or the rest of the bidders. The number of bidders, n, and the distributions F_v (.) and F_{SIv} (.) are common knowledge.

Each bidder must submit his bid, consisting of the fraction of the good that he requests at each price, to the seller. The price and quantity combinations constitute his individual demand. Adding up all individual demands, the seller can determine the market equilibrium price; that is, the price at which aggregate demand adds up to one.

Let us define x_i (.,.) as bidder *i 's* strategy in the primary auction. This strategy is a function of the good's price p and of the signal s_P so that when bidder i gets the signal $S_i = s_i$, his bid specifies that he will demand a share x_i *(p, s_i).* In a symmetric optimal strategies equilibrium x_i *(p, s_i)* = x_i (.,.) for all *i.*

Along with this notation, the equation that defines the market equilibrium of the primary auction under the uniform price format as a function of the equilibrium price $p°$ is written as:

$$(1) \qquad \sum_{j \neq i} x\left(p^0, s_j\right) + y\left(p^0, s_i\right) = 1$$

This equation depends on bidder *i's* signal and on the signals received by each one of the other bidders, which are unknown to bidder ¿. As a result, the equilibrium price $p°$ is also unknown to bidder *i.* However, since bidder i know the probability distribution function from which he extracts signals and the function x_i *(p, s),* he can determine the conditional distribution of the random variable *P°:*

$$(2) \qquad H(p; v, y) = \Pr\left\{P^0 \leq p \middle| V = v, y(p, s_i) = y, S_i = s_i\right\}$$
$$= \Pr\left\{\sum_{j \neq i} x(p, S_j) \leq 1 - y \middle| V = v, y(p, si) = y, S_i = s_i\right\}$$
$$= \Pr\left\{\sum_{j \neq i} x(p, S_j) \leq 1 - y \middle| V = v\right\}$$

If a uniform price auction format is employed, bidder i's expected benefit when he resorts to strategy y (.,.) and the good's value and equilibrium price are, respectively, v andp^0 is:

$$(3) \qquad E\left\{\int_0^{\infty} (V - p) y(p, s_i) dH(p; V, y(p, s_i)) \middle| S_i = s_i\right\}$$

where the expected value is with respect to V given $S_i = s_i$. The strategy x (...) indeed is optimal if the maximum of equation (3) is attained at y (...) = x (...). A solution to this optimization can be characterized by resorting to calculus of variations. The necessary condition for a maximum is that for all $p \in [0, \infty]$:

$$(4) \qquad E\left\{(V-p)\frac{\partial H(p;V,y)}{\partial p}+x(p,s_i)\frac{\partial H(p;V,y)}{\partial y}\Big|S_i=s_i\right\}=0$$

where partial derivatives of *H* with respect to *p* and *y* are evaluated at *y = x (p, s).* On the other hand, if a discriminatory price auction format is employed, bidder *i's* expected benefit becomes:

$$(5) \qquad E\left\{\int_0^{\infty}\left[(V-p)y(p,s_i)-\int_p^{p_{max}} y(u,s_i)du\right]dH\left(p;V,\mathbf{y}(p,s_i)\right)\Big|S_i=s_i\right\}$$

The Euler equation derived to maximize this expression is:

$$(6) \qquad E\left\{(V-p)\frac{\partial H(p;V,y)}{\partial p}-H(p;V,y)\Big|S_i=s_i\right\}=0$$

and it has a corresponding empirical counterpart, as derived by FPV, written as:

$$(7) \qquad \begin{aligned} &E\left\{(n-1)\cdot\left(E(V\big|S_1=s_1,\ldots,S_n=s_n)-p\right)\cdot 1\left\{P^0\le p\right\}\right\} \\ &-E\left\{(p-P^0)\cdot 1\left\{P^0\le p\right\}\right\}=0 \end{aligned}$$

where the first expected value is with respect to the signals $S_1,\ldots,S_n$ (the random variable P^0 only depends on these signals), the second one is with respect to V given $S_1,\ldots,S_n$, the third one is with respect to P^0, and $1\{\cdot\}$ is the indicator function. This condition is satisfied for all $p \in [0,\infty]$. Then the objective is to find an estimator of θ^0, the true value of θ, defined as the minimum of the empirical counterpart of the Euler condition derived from the bidders utility maximization problem. Using this condition to estimate the structural parameters of the model makes it essential to find a way to compute the conditional expectation $E\left(E(V\big|S_1=s_1,\ldots,Sn=sn\right)$, which is an unbiased estimate of V. The problem is that we do not observe the signals of the bidders $s_1,\ldots,s_n$. But we do observe their bids, so to overcome this problem FPV suggest assuming that bidders' strategies are strictly decreasing in their signal, s_i. With this assumption, the authors can use observed bid functions instead of the unobserved signals to form the above conditional expectation. In particular, if bid strategies, $x(p, s_i)$, are strictly decreasing in the signals, s_i, then the quantiles of $x(p, s_i)$ can be equated to quantiles of s_i to "invert" an observed bid $x(p, s_i)$ to find its corresponding signal, s_i. This could well be deemed a very strong assumption that ought to be tested against data. Unfortunately, our data is not rich enough to permit it, so we adopt this working assumption and leave its testing for future research.

The estimation is carried through a two stage semi-parametric method that exploits the results of a set of L auctions that exhibit observed heterogeneity across them in terms of a number of participants N_l and of a vector of auction characteristics Z_l[20]. For auction l with characteristics z_l and n_l bidders, the Euler equation can be rewritten in terms of auction-specific variables as:

$$(8)\quad 0 = E\left\{(n_l - 1)\cdot(E(V_l \mid S_{1l} = s_{1l},\ldots S_{nl} = s_{nl}) - p)\cdot 1\left\{P_l^0 \le p\right\}\middle| N_l = n_l, Z_l = z_l\right\} - E\left\{(p - P_l^0)\cdot 1\left\{P_l^0 \le p\right\}\middle| N_l = n_l, Z_l = z\right\}$$

where the random variable P_l^0 represents the equilibrium price at auction l and the first expected value is taken with respect to $S_{il},\ldots, S_{nl,l}$ given $N_l = n_l$, and $Z_l = z_l$. This condition must hold for all $p \in [0, \infty]$ and all $l = 1,.., L$.

In Stage 1 the distribution of optimal bids, $G(x \mid n, z; p)$, is estimated non parametrically from the observed bids using Kernel estimation methods[21]. Let $K(.,.)$ be a Kernel and h_N and h_Z be the bandwidth parameters –*i.e.*, h_Z being the vector of bandwidth parameters for each characteristic z-. Then a non-parametric estimator of the distribution of optimal bidding strategies $G(\cdot \mid \cdot, \cdot, ; p)$ is:

$$(9)\quad \hat{G}(x \mid n, z; p) = \frac{\sum_{l=1}^{L} \frac{1}{n_l} \sum_{i=1}^{nl} 1\left\{x_{ilp} \le x\right\} K\left(\frac{n - n_l}{hN}, \frac{z - z_l}{h_Z}\right)}{\sum_{l=1}^{L} K\left(\frac{n - n_l}{h_N}, \frac{z - z_l}{h_L}\right)}$$

Once this distribution function is obtained, for any θ, the unobserved signals appearing in the above equation are replaced with the estimated inverse demand functions (since $\tilde{x}^{-1}(x, p, S_{il}, n, z; \theta) = F^{-1}_{SIZ}\left(1 - \hat{G}(x \mid n, z; p) \middle| z; \theta\right)$ and also $s_{il} = x^{-1}(x, p, S_{il}, n, z; \theta^0)$)[22]. Then, the following empirical counterpart for the right hand side of equation (8) is considered:

$$(10)\quad m(x_{11p},\ldots, x_{nlLp}, n_1,\ldots, n_L, p_1^0,\ldots, p_L^0, z_1,\ldots, z_L, p; \theta) = \sum_{l=1}^{L}\Big[\Big(E(V_l \mid S_{1l} = \tilde{x}^{-1}(x_{1lp}, p, n_l, z_l; \theta),\ldots, S_{nil} = \tilde{x}^{-1}(x_{nllp}, p, n_l, z_l; \theta), N_l = n_l, Z_l = z_l) - p\Big) \times (n_l - 1) 1\left\{p_l^0 \le p\right\} - (p - p_l^0) 1\left\{p_l^0 \le p\right\}\Big]$$

Stage 2 consists of minimizing with respect to *9* the squared sum of a fixed number T of empirical moments (FVP choose T equal to the number of auctions in the sample)[23]. In effect:

$$(11)\quad \hat{\theta} = Arg\min_{\theta} \sum_{t=1}^{T} m^2(x_{11p_t},\ldots, x_{n_l L p_t}, n_1,\ldots, n_L, p_1^0,\ldots, p_L^0, z_1,\ldots, z_L, p_t; \theta)$$

At the first estimation stage, the optimal bidding strategies' distribution function is estimated using the *Epanechnikov* Kernel. This kind of estimation requires a vector of observations, denoted as $z = (z^1, z^2, z^3)$, to evaluate the Kernel for each of the variables *z.* Hence, the Kernel estimator is defined as follows:

$$(12)\quad K\left(\frac{n-n_l}{h_N},\frac{z-z_l}{h_Z}\right)=K\left(\frac{n-n_l}{h_N}\right)K\left(\frac{z^1-z_{1l}}{h_{1Z}}\right)K\left(\frac{z^2-z_{2l}}{h_{2Z}}\right)K\left(\frac{z^3-z_{3l}}{h_{3Z}}\right)$$

where $K(u) = 0.75\ (1 - u^2)1\{|u|\leq 1\}$ and h_N, h_{1Z}, h_{2Z}, and h_{3Z} are bandwidth parameters[24].

Next, it is necessary to choose the parametric specifications for the signal and valuation distribution functions. The distribution function of V_l given $Z_l = z_l$ is:

$$(13)\quad F_{V|Z}\left(v\middle|z_l;\theta_1\right)=\int_0^v \gamma u^{\gamma-1}\frac{\beta_l^{\alpha_l}}{\Gamma(\alpha_l)}u^{\gamma(\alpha_l-1)}\exp\left[-\beta_l u^{\gamma}\right]du$$

where $\alpha_l = (1, z_l) \cdot \alpha$ and $\beta_l = (1, z_l) \cdot \beta \cdot \Gamma(\cdot)$ is the gamma function, α and β are parameter vectors of 4×1 dimension, and γ is a scalar. If $\gamma = 1$ the distribution described in equation (13) is a gamma distribution with parameters α_l and β_l, while if $\gamma \neq 1$ then V_l^{γ} follows a gamma distribution with parameters α_l and β_l. Note also that $\theta_1 = (\alpha', \beta', \gamma)$.

The probability distribution of S_{il} given $V_l = v$ and $Z_l = z$, is specified with the exponential distribution:

$$(14)\quad F_{SIV,Z}\left(s\middle|v_l,z_l;\theta_2\right)=1-\exp\left[-sv_l^{\gamma}\right]$$

where γ is the same parameter that appears in the conditional distribution of V_l. In this case, the conditional expected value and the conditional variance of S_{il} are independent of z_l. So the complete vector of parameters is: $\theta = (\alpha', \beta', \gamma)$; that is θ, which has 9×1 dimension.

Under these two specifications proposed by FPV, the conditional expectation of V_l that appears in the empirical moment $m(.)$ is:

$$E\left(V_l\middle|S_{1l}=\bar{x}^{-1}(x_{1lp},p,n_l,z_l;\theta),\ldots,S_{nll}=\bar{x}^{-1}(x_{nlp},p,n_l,z_l;\theta),N_l=n_l,Z_l=z_e\right)=$$

$$(15)\quad =\frac{\Gamma\left(n_l+\alpha_l+\frac{1}{\gamma}\right)}{\Gamma(n_l+\alpha_l)}\frac{1}{\left(\beta_l+\sum_{i=1}^{n_l}\beta_l\left[\frac{1}{\hat{G}\frac{1}{\alpha_l}\left(x_{ilp}\middle|n_l,z_l;p\right)}-1\right]\right)^{\frac{1}{\gamma}}}$$

Once this expression is appropriately substituted into equation (11), we can proceed with the second stage estimation through generalized methods of moments of $\theta°$, the true value of $\theta°$ FPV select the value of T equal to the number of auctions or stop-out prices. The corresponding standard errors are computed with the asymptotic variance-covariance matrix derived in the Appendix C of FPV.

Given these estimated values of θ and using equation (11), $E(V_l \mid Z_l = z_l)$ can be computed as follows:

$$(16) \quad E\left(V_l \middle| Z_l = z_l\right) = \int_0^\infty v f\left(v \middle| z\right) dv = \frac{\Gamma\left(\alpha_l + \frac{1}{\gamma}\right)}{\Gamma(\alpha_l)} \cdot \beta_l^{-\frac{1}{\gamma}}$$

FPV's specifications have the property of allowing us to obtain closed form solutions for optimal strategies and equilibrium prices in the uniform price auction. In fact, Wilson's share auction with the uniform format has multiple equilibria and - depending on which equilibrium is played - the price in the auction may be anything between the seller's reservation price and the "true value" (Back and Zender, 1993). Despite this, the optimal strategy derived by FVP actually is the unique equilibrium strategy in the class of demand functions that are linear in the individual signal's value, under the above distributional assumptions[25]:

$$(17) \quad x\left(p, s_{il}, n_l, z_l; \theta\right) = \left[1 - \left\{\frac{\beta_l}{n_l} + s_{il}\right\}\left\{\frac{\Gamma(n_l + \alpha_l)}{\Gamma\left(n_l + \alpha_l + \frac{1}{\gamma}\right)} \frac{1+\gamma}{\gamma} p\right\}^\gamma\right] \cdot \frac{1}{n_l - 1}$$

That is, the closed-form expressions of the optimal strategy in a uniform auction that result from the parametric specifications (13) and (14). Then the equilibrium stop-out price at the *l-th* uniform price auction, as a function of the estimated signals and parameters is:

$$(18) \quad p_l^0 = \frac{1}{1+\frac{1}{\gamma}} E\left(V_l \middle| S_{1l} = s_{1l}, \ldots, S_{n_l l} = s_{n_l l}, Z_l = z_l\right) =$$

$$= \frac{1}{1+\frac{1}{\gamma}} \frac{\Gamma(n_l + \alpha_l)}{\Gamma\left(n_l + \alpha_l + \frac{1}{\gamma}\right)} \frac{1}{\left(\beta_l + \sum_{i=1}^{n_l} s_{il}\right)^{\frac{1}{\gamma}}}$$

Therefore, we can obtain the stop-out price replacing θ and s_{il} in the above expression by their estimates. Then we can compute the hypothetical revenue from uniform price auction *I* as the product of the equilibrium price times the amount of bonds auctioned, and the total hypothetical income under the uniform auction derives from the summation over all the sample auctions.

4. RESULTS

4.1 Parameters

For our estimations, the dimension of zi is equal to 3 and includes the secondary market price (in pesos), the maturity (in days) and the nominal yield (in percentage) as shown in Table 2[26]. Our calculated values are h_N = 20.6216, h_{1z} = 3.3344, h_{2z} = 3.6252, and h_{3z} = 99.8950. Notice that these values agree with the data of Table 5, because the number of bidders and nominal yield exhibit a higher

variance than the secondary market price and maturity.

TABLE 5
MEAN OF DIFFERENCE IN REVENUE – DISCRIMINATORY MINUS ESTIMATED UNIFORM
(In millions of pesos)

Mean	Mean Bootstrap	Confidence interval (95%)	
		Lower bound	Upper bound
–6.3968	–7.4383	–8.4476	–4.5051

The number of moments we chose to estimate equation 10 is T = 180.[27] Table 4 shows our estimates. All parameters are significant and different from zero at 5% confidence level.

TABLE 4
SECOND STAGE ESTIMATE OF θ

Estimate of alpha:	Coefficient	Standard Error
Constant	–15.2771	0.97630
Secondary market price	148.4281	0.92758
Nominal yield	–12.5593	0.11267
Maturity (Divided by 364)	–4.7492	0.43610
Estimate of beta:		
Constant	–29.8005	0.63808
Secondary market price	151.1429	0.60659
Nominal yield	12.9369	0.07355
Maturity (Divided by 364)	0.3889	0.28267
Gamma	118.7335	0.66655

We evaluate the derivatives of equation 16 with respect to each of the variables at the sample mean of the characteristics. The values obtained for the derivatives with respect to secondary market price, nominal yield, and maturity are -0.0804, -0.1769, and -0.1265, respectively[28]. Although the first sign is not very intuitive, the last two are because we usually expect securities' value to increase as the secondary market price is higher and the nominal yield and maturity are lower.

4.2 Conditional mean and variance.

The average estimated expected value given the signals, $E\left(V_l \middle| S_{1l} = s_{1l}, \ldots, S_{nl} = s_{nl}, Z_l = z_l\right)$, is equal to 0.9910 and the average value, $E\left(V_l \middle| Z_l = z_l\right)$, is equal to 1.0004. In turn, the average spread between $E\left(V_l \middle| S_{1l} = s_{1l}, \ldots, S_{nl} = s_{nl}, Z_l = z_l\right)$ and the stop-out price is 0.0237, while the spread between $E\left(V_l \middle| Z_l = z_l\right)$ and the stop-out price is 0.0332[29]. Notice that it seems more natural that the spread increases with the good's value because, if the good is valuable, competition should be stronger and the resulting stop-out price should be lower. However, the data indicate that this is the case only for the average expected value.

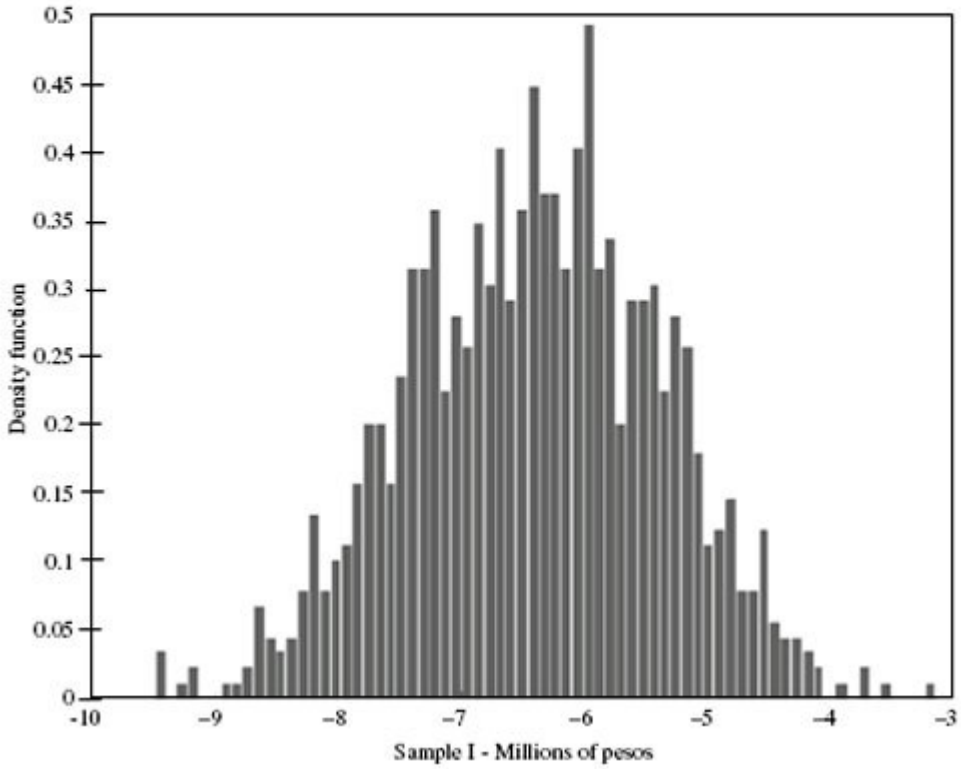
4.3 Comparing revenues

The total hypothetical revenue obtained is 80,918.48 billion pesos, while the revenue observed in the discriminatory auction is 79,767.05 billion pesos. Hence, if the Federal Government had used the uniform price mechanism to auction its securities instead of the discriminatory price mechanism, it would have raised an additional 1,151.42 billion pesos, that is, the revenue would have been 1.44% higher.

In order to test the significance of these estimates, we calculate the bootstrapped confidence intervals of the difference in revenue per auction (Table 5)[30], and find a significant difference between the discriminatory and the uniform auction. The bootstrapped mean of the difference is approximately 6 million pesos, with an upper bound of 8.44 million pesos and a lower bound of 4.50 million pesos.

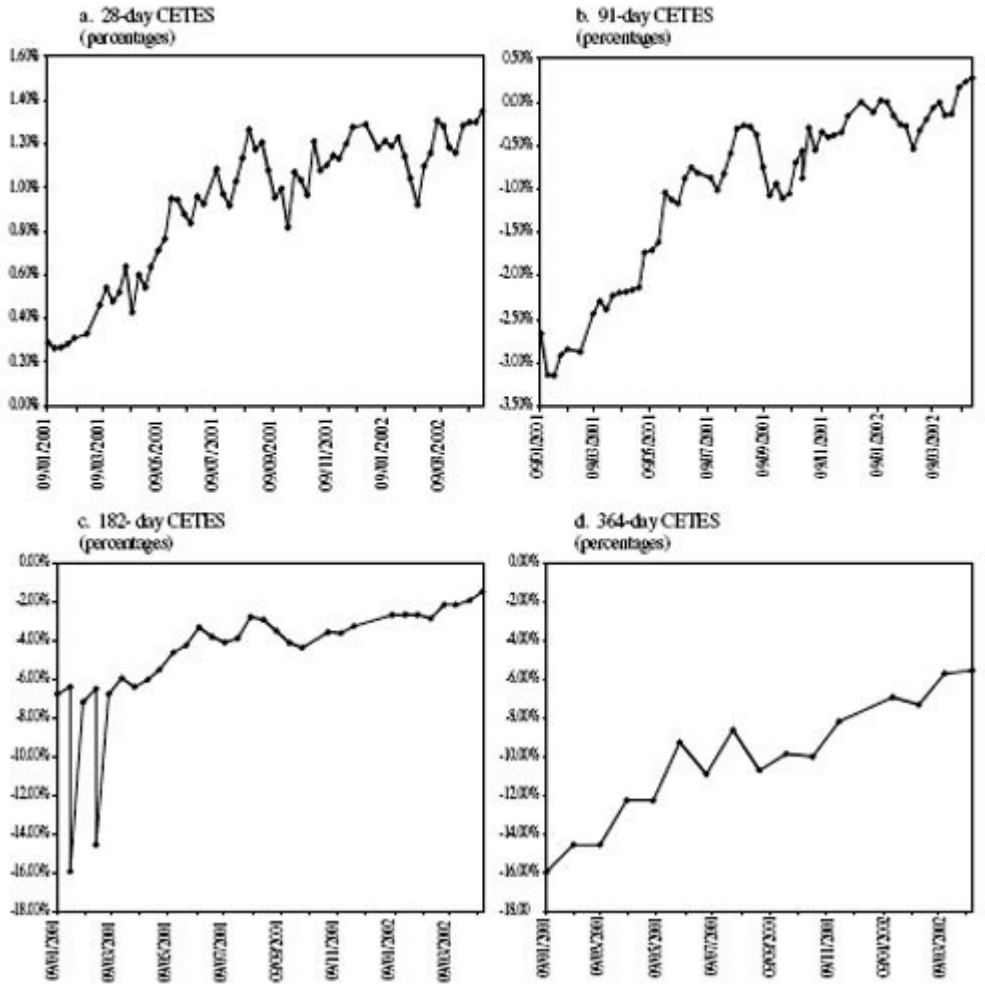
In addition, we calculated the bootstrapped interval several times and found that their figures do not change across calculations. The aggregated difference seems small, but it is considerably negative in each auction. The estimated density function for the difference in revenue is shown in Figure 1.

FIGURE 1
BOOTSTRAP DENSITY FUNCTION OF THE DIFFERENCE IN REVENUE
BETWEEN THE DISCRIMINATORY AND THE UNIFORM AUCTION FORMATS
(Millions of pesos)



There are two other interesting features of these results. First, the uniform auction's revenue superiority differs across CETES with different maturity. Second, for all maturities this revenue superiority diminishes throughout the analysis period. Actually, in the case of the 28-day CETES, the discriminatory scheme obtains higher revenues than the uniform one. Benefits derived from the discriminatory auction increase through time, from 0.3% to 1.35%. For the rest of the CETES, the uniform price auction is higher in revenue. In the 91-day CETES auctions, the benefits involved in implementing a uniform price auction go from 2.66% to a loss of 0.28%. In the 182-day CETES auctions, this benefit falls from 7% to 1.4%. Finally, benefits from selling the 364-day CETES, when they are at their highest, decrease from 10% to 5% (See Figure 2).

FIGURE 2
DIFFERENCE IN REVENUE BETWEEN THE (OBSERVED) DISCRIMINATORY AUCTION AND THE (HYPOTHETICAL) UNIFORM AUCTION



The date after which the revenues from discriminatory auctions begin to rise in a noticeable manner is May 2001; this date corresponds to the implementation of new rules for non-competitive bidding in the market makers' buy option. Since we cannot explain this phenomenon within the frame of the analytical setting of this paper, let us only state a conjecture regarding the effects of this change. These new rules determine the maximum quantity allocation as a function of these agents' competitive bids submitted in the primary auction, featuring a small interval around the lowest price (highest rate) that receives an allocation at the primary auction, instead of the total amount allocated to it. Setting rules that promote stronger competition among market makers may have contributed to a more aggressive bidding in the primary auction and, therefore, the differential in revenue between the two auction formats may have fallen. Alternatively, the market making mechanism may have been becoming more effective in disseminating information across the secondary market.

5. EXPLORING THE ROLE OF MARKET UNCERTAINTY

5.1 A comparison with the previous results for CETES and French Treasury securities auctions

In this model, one possible reason why the uniform price auction may produce

higher sales revenue than the discriminatory one is that the conditional variance of the value obtained in this exercise is considerably higher than the one that FPV obtain. We may interpret this as a higher degree of uncertainty in the good's value, which would be a reason for more cautious bidding in the discriminatory auctions in Mexico than those in France. In this sense, the values of α_1 and β_1 evaluated at the sample mean of z can be seen in Table 6. It is important to remember that in this case V^Y_1 follows a gamma distribution with parameters $\alpha_1$and β_1.

TABLE 6
α_t, β_t, CONDITIONAL MEAN, VARIANCE AND VARIATION COEFFICIENT OF V^Y

	α_t	β_t	Mean (α_t/β_t)	Variance (α_t/β_t^2)	Variation coefficient
CETES auctions of January 2001-April 2002	125.68	117.97	1.0653	0.0090	0.0891
Février,Préget, and Visser (2004)	3045.04	848.72	3.5878	0.0042	0.0181

Note: Evaluated at the characteristics' sample mean.

According to the table's data, the distribution of V^Y_1 in our sample exhibits a higher variance than the one obtained in FPV. We can appreciate this higher dispersion in a better manner by looking at the coefficients of variation.

Therefore, we can state that the Mexican market shows more value uncertainty than the French market.

Let us now compare our findings with the previous ones of Umlauf (1993) and Laviada *et al.* (1997) for the 28-day CETES auctions. We construct the variance of the daily funding rate with government securities over the five-day period leading to and including the day on which the auction is conducted -that is, the variable used to proxy resale risk and information dispersion in those studies- for the periods examined in each of the three studies. For the first two periods, we calculate the revenue of the discriminatory format as the product of the amount issued times the average allocation price. Next, we estimate the revenue of the hypothetical uniform auction as the amount issued times the sum of the average allocation price plus the positive mark-up per bid in the uniform auction with respect to the discriminatory format reported by those authors. Finally, we subtract the former from the latter to obtain the difference in revenue. Table 7 shows a positive relationship between the gains of using the uniform format and market uncertainty; that is, the gain is positive in the auctions examined by Umlauf and Laviada *et al,* and negative in those that we examined. In turn, we may connect this to higher market volatility in those samples than in ours.

TABLE 7
AUCTION REVENUE AND MARKET VOLATILITY COMPARISON WITH PREVIOUS REDUCED FORM ESTIMATIONS FOR 28-DAY CETES

Analysis Date	Auction format dummy variable	Discriminatory Auctions' observed revenue (millions of pesos)	Uniform Auctions' Hypothetical Revenue (millions of pesos)	Revenue Difference (%)	Variance of the funding rate
Aug 1986- May 1991 (Umlauf, 1993)	2.44[bp]	74	74	0.000%	0.160
Jun 1995- Mar 1997 (Laviada *et al.*, 1997)	18.96[bp]	8,558	8,558	0.002%	3.498
Jan 2001-Apr 2002 (present)	–	29,657,590	29,398,573	–0.873%	0.096

Next, we look for this same positive relationship in our cross maturity results. As different resale price volatility across CETES maturities are needed for this exercise, we construct the variance of resale price with the *Enlaces Prebon* CETES secondary market price index (IEP index)[31]. In addition, we only look at 17 auctions of each maturity date, because the 364-day CETES are auctioned monthly. Table 8 once again shows the positive relationship between the gains derived from using the uniform auction format and market volatility in CETES with maturities of 28, 91 and 182 days. We think that this is due to a low transaction volume problem affecting issues with longer maturities to a greater extent than the resale market for the latter securities that is, in fact, less uncertain than those of the shorter term maturities[32].

TABLE 8
AUCTION REVENUE AND MARKET VOLATILITY COMPARISON ACROSS MATURITIES

CETES Maturity	Discriminatory Auctions' observed revenue (millions of pesos)	Uniform Auctions' hypothetical revenue (millions of pesos)	Revenue Difference (%)	Variance of the IEP index
28 days	7,572.253	7,518.962	–0.70%	0.052
91 days	8,564.527	8,690.297	1.47%	0.064
182 days	5,321.119	5,511.703	3.58%	0.067
364 days	7,141.314	7,807.403	9.33%	0.046

5.2 Simulation exercise with noisier value signals

In this section, we test whether market uncertainty affects bidding within the structural model framework. First, we generate a more volatile series of the secondary market price, and use it to estimate stage 1 signals' distribution and to generate new model parameters.

The new series of secondary market prices is modeled as the observed secondary market price with an AR(1) process -conditional on the CETES maturity- plus *Ltd.* shocks. This model yields a variance of shocks of 2.55 and an autoregressive parameter p = 0.091. Next, we use the AR(1) approximation method proposed by

Tauchen (1986) to simulate 180 new data of the secondary market price. We assume that the new series has the same variance as that for the period between June 1995 and March 1997 analyzed by Laviada *et al.* (1997); that is, a variance of the daily funding rate equal to 3.49 according to Table 14.1. Though this variance is 55% higher than the one observed in our data set, we can still regard it as a conservative simulation in view of the Mexican market experience.

Table 9 shows the resulting parameters. We can observe a higher estimated value of the parameter γ, which can be interpreted as consistent with a setting in which the bidders face less informative signals. In fact, as the value of γ increases V^{γ} decreases (recall that $0 < V < 1$), the distribution of signals, $F_{s|v,z}\left(s|v_1,z_1;\theta_2\right)=1-\exp\left[-sv_1^{\gamma}\right]$ collapses. On the other hand, as this happens we would expect higher revenues from the uniform price. This is precisely what we find: the new total hypothetical revenue obtained from the uniform auction now is 81,506.33 billion pesos, which not only is 2.1% higher than the revenue observed from the discriminatory auctions, but it also exceeds by 0.7% the uniform auction revenue that was obtained before.

TABLE 9
SECOND STAGE ESTIMATE OF θ USING A SIMULATED SECONDARY MARKET PRICE SERIES DISTRIBUTED WITH MEAN 3.70 AND VARIANCE 3.49

Estimate of alpha:	Coefficient	Standard Error
Constant	327.1935	0.00000015
Secondary market price	162.8496	0.00001419
Nominal yield	20.2399	0.00000151
Maturity	447.9777	0.00000002
Estimate of beta:		
Constant	5.4844	0.00003000
Secondary market price	34.3807	0.00290531
Nominal yield	82.8601	0.00030871
Maturity	2031.6185	0.00000309
Gamma	745.6563	14.10575237

6. CONCLUSIONS

The share auction framework supporting the structural estimation method of FPV seems to provide an adequate characterization of Mexico's CETES auctions during the period under analysis. Although the coefficients are significant and have a plausible size, the estimated value of the securities does not seem to be too sensitive to changes in the auction characteristics considered. Moreover, the sign of some of the coefficients are not very intuitive and differ across the samples analyzed. While some small sample bias may explain these findings, a selection criterion may be needed to enable us to choose from among a set of several possible exogenous variables those that can best describe the auction heterogeneity. Such development may contribute to raise the power of the estimation procedure and extend its applicability to other securities for which there is less data available than in the case of the zero coupon bonds, particularly in what respects market prices. On the other hand, FPV's estimation approach relies on specific distribution functions that yield tractable analytical solutions. However, despite this we think that experimenting with other parametric

specifications of the value and the individual signals may also be desirable in the future, both to assess the method's robustness and, more generally, to study other game theoretic models for which no explicit strategies can be found (due to either complexity or lack of data).

Our results indicate that the uniform price auction produces higher CETES sales revenue than the discriminatory price auction during the period studied. The difference in revenue is 1.68% and is statistically significant. However, some back-of the envelope calculations could well be enough to give us some grasp of this finding's economic significance. The average issue size of the sample constituted by 180 auctions is 4,500 million pesos. This is equal to 2.5% of the overall outstanding CETES debt issued by the Mexican Treasury during the period under analysis (that is, each week the CETES debt is adjusted by 2.5%). Outstanding CETES debt represents 3% of Mexico's GDP. Therefore, the difference in revenue is grossly 0.22% of GDP (0.03*0.025*0.0168*180). Coincidentally, according to the Mexico's Ministry of Finance, the primary fiscal deficit target for the end of the year stated in the 2005 Economic Program is precisely 0.22% of GDP![33] This evidence confirms the previous estimations with reduced form estimations for 28-day CETES auctions and provides a robustness check on FPV's structural estimation method (which obtained the opposite revenue ranking for French Treasury securities). In addition, we find new evidence that suggests that CETES' market volatility has diminished across the analyzed episodes, which would diminish some of the benefits of using the uniform auction format instead of the discriminatory one[34,35]. As a result, the difference in revenue between auction formats that we find in this study is lower than in Umlauf's or Laviada's.

We also detect that the difference in revenue between the two auction formats varies across CETES with different maturities. The discriminatory format produces higher revenue than the uniform format in the 28-day securities auctions, while the uniform format produces higher revenue than the discriminatory format in the 91,182, and 364 -day securities auctions. This positive relationship between the gains of the uniform format and the securities' maturity coincides with the practice, by the Mexican Treasury as well as by other countries' debt issuing agencies, of selling securities with short maturity with the discriminatory format and long-term securities with the uniform auction format[36].

Finally, the results obtained in the simulation exercise shed some light on the relevance of market uncertainty when a country chooses an auction technique to sell bonds. In this particular example, a bond sale in a market with higher level of uncertainty, depicted by private signals featuring higher variance, will yield more revenue under a uniform format. However, within the frame of a particular technique, it may be interesting to consider uncertainty with respect to other characteristics, such as, for instance, the issue size or maturity. Some recent theoretical models have not only proposed that quantity uncertainty can affect revenue ranking between uniform and discriminatory format, but also that some debt issuing agencies deliberately introduce quantity uncertainty in their auctions; this is because as bond markets develop, issuing agencies are moving towards publishing their calendars in advance. Furthermore, some securities are being issued with greater frequencies than others. While these aspects are perceived as desirable, the methodology used in this paper, that is, estimations with FPV's structural model complemented by the kind of simulation exercise that we performed in section 5.2, may produce some evidence as to the extent to which such aspects may matter. These empirical results set a useful baseline for further research in other developing markets.

NOTES

[1]For instance, in September 1991, in the wake of Solomon Brothers' admissions of deliberate and repeated violations of Treasury auction rules, the Treasury Department, the Federal Reserve and the Securities Exchange Commission undertook a joint review of the government securities market. Among a broad range of issues, the report addressed the need to (i) strengthen enforcement of Treasury's auction rules, (ii) automate the auctions, (iii) introduce potential changes in Treasury's auction technique and debt management policies, and (iv) define the role of primary dealers. In such Joint Report, the three agencies considered that any degradation in the smooth functioning of the government securities market would result in higher costs to the taxpayer; at that time, they estimated that an increase in financing costs of only one basis point would cost taxpayers over $ 300 million each year.

[2]Perhaps the best-documented format switch occurred after 1994, this time from the discriminatory to the uniform one, occurred again in the United States in 1999, after carrying out an explicit series of experiments on auction formats. For details, see Malvey *et al.* (1995) and Malvey and Archibald (1998).

[3]Nonetheless, the Mexican Treasury has been using the uniform format to issue securities with maturities longer than a year and a fixed rate at least since 2001.

[4]See, for example, Orellana et al. (2007).

[5]Back and Zender (1993) and Bikhchandani and Huang (1993) provide more detailed explanations on the similarities between treasury securities auctions and Wilson's share auction model.

[6]In fact, a handbook for developing government bond markets of the World Bank and the IMF contains the following recommendation: "As much aggregate information as possible should be disclosed after the auction. No information should be disclosed that might identify individual bidders." (Page 162).

[7]Other agents specifically authorized by Banco de México, the Central Bank, can also bid and buy treasury securities.

[8]Mexico's central bank website address is http://www.banxico.org.mx.

[9]These announcements, in turn, follow the quarterly issuance calendar of the Ministry of Finance.

[10]Discount rates must be expressed in percentage points, up to two decimal points, in yearly terms and based on years of 360 days.

[11]After September 2002 the rule is that the Treasury only can declare the whole auction deserted if discount rates are too high, but this new rule has not been used either.

[12]Sistema de Atención a Cuentahabientes del Banco de México (SIAC-Banxico), in Spanish.

[13]Instituto para el Depósito de Valores (S. D. INDEVAL). INDEVAL is the only firm in México authorized to operate as a depository of securities. The services it must provide include custody, administration and transfer of securities, as well as operation compensation and liquidation.

[14]We sketched a two-stage model that takes into account this buy option and estimated the FPV model using only a sample that would be consistent with Wilson's share auction model; that is, the sample of primary auctions after which the market makers' buy option was empty. This exercise suggests that the characterization of the CETES as a share auction was adequate because the securities allocations through the market makers' buy option have been a small proportion of the total amount issued by the Mexican Treasury. However, the potential asymmetry among bidders that the market makers' buy option may introduce did not affect the estimated parameters substantially across the samples. A more detailed description of Mexico's market makers mechanism, the model sketch and the estimation results are available in Spanish in the working paper version of this paper, Castellanos and Oviedo, 2004.

[15]CETES issues with maturity of 27, 90, 168, 182, 335 or 363 days, that result from computing the securities' maturity according to the number of market days and from the practice of "reopening" the 182 and 235 days issues to improve their liquidity, for presentation purposes are grouped with the closest of the 4 basic issues.

[16]See Gordy (1996) for a more detailed presentation of this idea.

[17]Notice that asymmetry across bidders may also be the result of different costs of obtaining or placing customers offers.

[18]For the 28-day CETES auctions of the period 1986-1991, see Umlauf (1993), whose data permits distinguishing bidders' sizes and also provides evidence suggesting that there is asymmetric information between large and small bidders. However, it should be noticed that, due to the consolidation of the banking industry in Mexico, there are fewer but larger banks in the period analyzed.

[19]More details about the asymptotic properties of FPV's semi parametric two-stage estimator are also available in Newey and McFadden (1994).

[20] To this end, the random variables (N_l, Z_l), $l = 1, \ldots, L$, are assumed to be independently and identically distributed. The good's value in the l-th auction, V_l and the signal received by bidder i in the auction l, S_{il} (dependent on V_l), are assumed to be dependent of Z_l and independent of N_l. The value realizations of $V_1,\ldots,V_L$, conditional on Z_l, are independently and identically distributed. $S_{1l},..S_{nl}$ are independent conditional on Z_l and V_l, and the signals S_{il} and $S_{i\,l'}$ are also independent conditional on Z_l and $Z_{l'}$ for all $l \neq l'$. In addition, the respective conditional distribution functions of V_l and S_{il} are denoted $F_{V|Z}(\cdot\,|\,z;\theta_1)$ and $F_{S|V,Z}(\cdot\,|\,v,z;\theta_2)$, where θ_1 and θ_2 are parameter vectors. From these two distributions, the one for S_{il} given $Z_l = z$, $F_{S|Z}(\cdot\,|\,z;\theta)$, where $\theta = (\theta_1', \theta_2')'$, can be determined.

[21] Pagan and Ullah (1999).

[22] This follows from the definition of $G(x|n,z;p) = \Pr\left(x\left(p,S_{il},N_l,Z_l;\theta^0\right) \le x \,\middle|\, N_l = n, Z_l = z\right)$, assuming that S_{il} and N_l are conditionally independent, when the optimal strategy is a decreasing function of the signal.

[23] Though, FPV note that since equation (9) is satisfied for an infinite number of prices, there exists an infinite number of moments and, for each of these theoretical moments, there exists an empirical counterpart with the form of equation (10).

[20] To this end, the random variables (N_l, Z_l), $l = 1, \ldots, L$, are assumed to be independently and identically distributed. The good's value in the l-th auction, V_l and the signal received by bidder i in the auction l, S_{il} (dependent on V_l), are assumed to be dependent of Z_l and independent of N_l. The value realizations of $V_1,\ldots,V_L$, conditional on Z_l, are independently and identically distributed. $S_{1l},..S_{nl}$ are independent conditional on Z_l and V_l, and the signals S_{il} and $S_{i\,l'}$ are also independent conditional on Z_l and $Z_{l'}$ for all $l \neq l'$. In addition, the respective conditional distribution functions of V_l and S_{il} are denoted $F_{V|Z}(\cdot\,|\,z;\theta_1)$ and $F_{S|V,Z}(\cdot\,|\,v,z;\theta_2)$, where θ_1 and θ_2 are parameter vectors. From these two distributions, the one for S_{il} given $Z_l = z$, $F_{S|Z}(\cdot\,|\,z;\theta)$, where $\theta = (\theta_1', \theta_2')'$, can be determined.

[25] Such class of linear demand functions has the form $x(p, S_{il}, n_t, z_t; \theta) = a(p, n_t, z_t; \theta) + b(p, n_t, z_t; \theta) s_{it}$, with the only restriction that functions $a(\ldots;\theta)$ and $b(\ldots;\theta)$ are such that $x(\ldots;\theta)$ is decreasing in p and s_{it}.

[26]The nominal yield is the weighted average rate of allocation.

[27]In FPV, T = 45. Since this number may be deemed somewhat small for a GMM estimation, we decided to take into account the information of all auctions in our dataset.

[28]These values are lower in magnitude than those calculated by FPV for the French securities auctions. The difference in magnitude of these results seems to be related to the magnitude of gamma and of the constants. For instance, both of the two gammas calculated in this exercise are higher than the one estimated in FPV.

[29] Estimations of $E(V_t | S_{1t} = s_{1t}, \ldots, S_{nt} = s_{nt}, Z_t = z_t)$, the secondary market prices, the stop-out prices, and $E(V_t | Z_t = z_t)$ for all auctions, computed from the estimators obtained for each sample, are omitted for the sake of briefness but are available from the authors upon request.

[30]The bootstrap procedure was carried out by making random sub-samples of the different auctions several times and calculating the difference in revenue each time given the estimators. With this, we were able to construct the distribution of the difference in revenue and its interval at 95% of this distribution. A difference in revenue equal to zero was the null hypothesis, which was rejected.

[31]Enlaces Prebon is one of the main inter-dealer brokerage firms operating in the Mexican Stock Market. The IEP index for CETES corresponds to the mean market interest rate at 12:15 a.m., determined through a survey to 12 participating institutions. The three highest and three lowest reported rates are eliminated, so the average rate is constructed from the remaining six reports. The index is constructed for CETES with 28, 91, 182, and 364 days maturity since June of 1996.

[32]IEP indexes are perception indexes, not executable indexes (there is no intention to buy or sell securities at the quoted rates). While this is probably the only public source of CETES secondary prices that covers our analysis period, this aspect may be a disadvantage for our purpose.

[33]Source: 2005 Economic Program, Ministry of Finance, Mexico, January 3, 2005.

[34]Besides market uncertainty, another common argument for the existence of a difference in revenue across the discriminatory and the uniform auctions of treasury securities refers to the possibility of collusion. Notice that in the case of Mexico, the existence of resale price uncertainty is very agreeable with this study's results. Although we do not look directly into the issue of collusion in repeated auctions, the usual argument is that the uniform format is more susceptible to this problem, which would predict the opposite differences in revenue that we would get given the frequency, size, and bidder participation conditions of the CETES auctions (see Table 3). Quantity uncertainty, another common argument for auction differences in revenue, is not an applicable argument in this case either, due to the fact the Mexican Treasury has been

publishing, for some years already, a quarterly debt issuance calendar in advance.

[35]In fact, according to a recent BIS report decreasing bond market volatility isa trend that is observed not only in Mexico, but also among several other emerging economies (for more details, see "Financial stability and local currency bond markets", Committee on the Global Financial System Papers No 28, BIS, 2007, or Eichengreen, Borensztein and Panizza, 2008).

[36]Sareen (2004) provides a brief cross-country survey of debt issuing practices.

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Interest Rate Pass-Through in Colombia: a Micro-Banking Perspective*

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Banks and other credit institutions are key players in the transmission of monetary policy, especially when the responses of deposit and loan interest rates to shifts in policy rates are among the most important channels. This pass-through depends on the conditions prevailing in the loan and deposit markets, which are, in turn, affected by macroeconomic factors. Hence, when setting their policy, monetary authorities must take into account those conditions and the behavior of banks. This paper shows this point using a micro-banking model and presents supporting empirical evidence based on monthly data for Colombia between 1999 and 2006.

Keywords: Monetary Transmission Mechanisms, Interest Rate Pass-Through, Banking.

Los bancos y otros establecimientos de crédito tienen un papel clave en la transmisión de la política monetaria, en la medida en que las respuestas de las tasas de interés de los depósitos y los créditos ante cambios en la tasa de política constituyen uno de los canales de transmisión más importantes. Esta transmisión depende de las condiciones que prevalecen en los mercados de depósito y crédito, los cuales, a su vez, son influidos por factores macro económicos. Por lo tanto, al fijar su política, las autoridades monetarias deberían considerar esas condiciones y el comportamiento de los bancos. Este artículo ilustra este aspecto mediante un modelo teórico microbancario y presenta evidencia empírica basada en datos

mensuales para Colombia entre 1999 y 2006.

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1. INTRODUCTION

In some economies, banks and other financial institutions play a key role in the expenditure decisions of firms and households. They are among the most important alternatives of funding and means of saving. As such, banks and bank behavior are critical components of the transmission mechanism of monetary policy. In particular, the interest rate channel of monetary policy, which operates when banks transmit the changes in the monetary policy rate to their customers' interest rates, depends on the banks' reaction to different shocks and to the state of the economy. Hence, when setting their policy, monetary authorities should take into account banks' behavior under different economic conditions.

This paper illustrates the idea that the response of market interest rates to changes in the policy interest rate depends on the reaction of banks and financial markets to different shocks hitting the economy. For that purpose, we develop a theoretical microeconomic model of the banking firm and the credit and deposits markets in which the effects of monetary policy and other macroeconomic variables are included. We also present some supporting evidence for the Colombian economy. The results from the empirical analysis (Error Correction - here after EC- and VARX models) highlight the importance of macroeconomic variables other than the policy interest rate in the transmission mechanism of monetary policy to the market interest rates.

Specifically, according to the EC models, a shock to the policy rate is transmitted to the bank deposit interest rates to a large extent. However, the estimated pass-through is incomplete in the short run for two measures of the deposit rates. For one of those measures, the estimated pass-through is also incomplete in the long run. At the same time, changes in the EMBI index (JP Morgan Emerging Markets Bond Index) have significant and large effects on the deposit rates, and other variables like industrial production, the depreciation of the currency and the LIBO rate have significant effects on the short-term dynamics of market rates.

The results from the VARX models show that the long run pass-through is complete for the two measures of the deposit interest rates used. In addition, the cumulative impulse response functions and the Granger Causality tests obtained from the VARX estimation indicate that other variables, especially the EMBI, have important effects in the determination of market interest rates.

The paper is organized as follows. A brief review of the literature is given in section 2. The theoretical model of the banking firm and the financial markets equilibrium is developed in section 3. Finally, some supporting evidence for the Colombian case is presented in section 4 and we conclude in section 5.

2. LITERATURE REVIEW

2.1 The Banking Sector and Interest Rate Pass-Through

The literature has identified different transmission mechanisms of monetary policy such as the interest rate channel, the credit channel and the exchange rate channel among others[1]. The importance of the banking sector in the transmission of interest rates has been recently recognized in the literature on the interest rate

channel[2]. At the same time, the credit channel has focused on the agency problems that arise between financial institutions, particularly banks, and the agents to which they lend *(e.g.* Bernanke and Gertler, 1995)[3]. Therefore, the credit channel is now considered as a set of factors that amplify and propagate the effects of the interest rate channel through their impact on lending rates and other interest rate spreads.

The banking sector has been incorporated in this literature, focusing mainly on the financial structure and information asymmetries[4]. These two elements clearly influence the behavior of banks and help explain why lending and deposit rates may show a limited response to changes in the monetary policy rate. From Hannan and Berger (1991) and Cottarelli and Kourelis (1994), the stickiness of bank lending interest rates after a change in the money market rates has been explained by different features of the financial structure. Empirical studies, like Berstein and Fuentes (2003) and Kot (2004) have found some degree of rigidity of interest rates in the short run and higher long-run interest rate pass-through coefficients. The degree of competition in the banking sector, the size of the bank, the types of customers and the loan risk level, among other financial features, have been found as the main determinants of interest rate flexibility[5].

Furthermore, depending on the country and also on the maturity of the interest rates, they may respond less than one-for-one to policy rates, so that the pass-through is incomplete at least in the short run *(e.g.* De Bondt, 2005). The macroeconomic implications of an incomplete long-run pass-through from policy to bank interest rates are analyzed by Kwapil and Scharler (2005), who find that, under these conditions, the Taylor Principle can be insufficient for equilibrium determinacy[6].

On a wider perspective, financial structure may influence interest rate pass-through by affecting the response of the financial markets to macroeconomic conditions. In particular, a macroeconomic shock may impact market interest rates directly and in addition to the response of the policy rate to the shock. In this sense, not only market rates may react with a delay to movements in policy rates, but also they may react more, less, or simply not react at all in the short run. As a result, the estimation of interest rate pass-through must control for the direct impact of other macro variables on market rates. This is the theme of our paper.

2.2 Interest Rate Pass-Through in Colombia

Studies for Colombia have found that, although there is a long-term relationship between policy and bank interest rates, interest rate pass-through is incomplete. Julio (2001) finds a stable long-term relationship between the interest rates in Colombia using cointegration for two periods, before and after the removal of the exchange rate band. Huertas *et al.* (2005) use descriptive statistics[7] to estimate that a 1% change in the monetary policy rate implies a change of 0.26% in the 90-day CDs interest rate in the short-run and a change of 0.6% in the long run[8]. Melo *et al.* (2006) using a multivariate VARX-GARCH model find a response of 38 basic points (b.p.) for the interbank interest rate and of 7 b.p. for the 90-day CDs rate to a change of 100 b.p. in the policy rate, during the period January 2001-September 2005.

Additionally, some of these studies have also documented the importance of the banking sector in Colombia and have suggested its significance in the transmission of interest rates. Huertas *et al.* (2005) show that bank credit was the most important source of funds for firms between 2000 and 2004[9]. However, they indicate that the rather low transmission of the monetary policy interest rate

to market interest rates can be explained by a loss in the effectiveness of the credit channel. They attribute this to the increase of banks' holdings of Government bonds as an alternative to loans[10], and to the declining share of bank loans as a source of funds for firms during this period[11].

Given the documented importance of the banking sector in the transmission mechanism in Colombia, a complete analysis of interest rate pass-through must involve bank behavior and the equilibrium in the loan and deposit markets, and its estimation must control for movements in other macroeconomic variables apart from the policy interest rate. Here we take into account these arguments to estimate the short run and long run interest rate pass-through for the Colombian case.

3. A MICRO-BANKING MODEL

Recently, microeconomic models of banks' behavior have been used to explain the role of financial structure in the transmission of interest rates. Berstein and Fuentes (2003) present a Monti-Klein model to explain the long run behavior of the banks under imperfect competition, taking into account the existence of credit risk. By using disaggregated data for different banks, they find that banks' characteristics can influence the degree of delay in the market interest rate response to changes in the policy rate. Kot (2004) uses a similar microeconomic approach to assess the impact of the degree of competition in the credit market on the interest rates pass-through. Amaya (2005) find empirical evidence for Colombia of the importance of banks' characteristics and inflation as long-run drivers of the market interest rates in a competitive setting.

Following this strand of the literature, a partial equilibrium model is used in order to explain the transmission of interest rates under a perfectly competitive structure of the banking sector. From this model, two main results are obtained. First, some macroeconomic variables apart from the policy rate are important determinants of equilibrium market interest rates. Second, the relationship between policy and market interest rates may not be "one-for-one" and possibly not even linear.

3.1 Assumptions

Following Freixas and Rochet (1997) we consider a micro-banking model which allows for the existence of liquidity risk. This risk appears when there is an insufficient amount of reserves to serve the total amount of withdrawals made by the depositors.

We assume that the level of reserves (R) chosen by banks and the amount of withdrawals (X) made by agents depend on the level of deposits, so $R = rD$ and $X = \tilde{x}D$ where $0 \le r \le 1$ and $\tilde{x} \in [0,1]$. This implies that the maximum amount of withdrawals is equal to the total amount of deposits[12] and that when $\tilde{x} \in (r,1]$, banks have to borrow the shortfall from the Central Bank, incurring a cost $I(D,r) = r_p D \mathrm{E}[\max(0, \tilde{x} - r)]$, where r_p is the policy interest rate. Further, we assume that the proportion of withdrawals follows a uniform distribution between 0 and 1, so that $\tilde{x} \sim U(0,1)$ and $I(D,r) = \frac{r_p D}{2}(1-r)^2$.

Additionally, to understand how credit risk affects the competitive pricing of loans, we introduce a simple approach in which banks can recover only a fraction *8 oí* the loans granted *(L).* The recovered proportion depends positively on the

economic conditions of agents, measured by the income *(Y)*[13], and negatively

on the loan interest rate (r_L)[14]. Therefore, only a proportion $\delta(Y, r_L)$ of the loans are paid back and only on this portion, agents pay interest. Thus, each bank has a net revenue given by $r_L\delta(Y,r_L)L-(1-\delta(Y,r_L))L$.

Since banking activity is modeled as the production of deposit and loan services, the technology is represented by a cost function $C(D, L)$ that can be interpreted as the cost of managing a volume D of deposits and a volume L of loans. The cost function is the same for all banks[15]. Moreover, it can be assumed without loss of generality that costs are separable (cross-effects are zero), which means that we don't take into account the existence of economies of scope in the joint production of loans and deposits.

Finally, we incorporate banks' holdings of government domestic bonds as an important decision variable, given that they have increased rapidly in Colombia since 2000. Thus, banks can invest in this riskless but illiquid asset (T), with return r_T.

3.2 The Bank's Problem

Assuming a given banking technology, we examine the behavior of this sector under a perfectly competitive structure, where there are Nrisk-neutral banks that are price takers[16]. Each bank chooses the volumes of deposits *(D),* loans *(L),* reserves *(R)* and government securities (I) that maximize profits subject to the balance sheet constraint:

This problem can be rewritten as follows:

$$(2)\quad Max\ \pi_{DLT} = r_L\delta(.)\left[(1-r)D-T\right]+r_TT-r_DD-(1-\delta(.))\left[(1-r)D-T\right][\ ]$$
$$-\frac{r_gD}{2}(1-r)^2-C\left(D,(1-r)D-T\right)$$
$$\text{s.t.}\ \begin{cases}0\le\delta\le1\\0\le r\le1\end{cases}$$

where bank's profits are the revenues on assets (loans and government securities[17]) minus the interest paid on the liabilities (deposits), the costs from credit and liquidity risks, and the operational costs.

Profit maximizing behavior for each bank is characterized by the following first order conditions:

$$(3) \qquad r_D = (1-r)\left[\delta(.)(1+r_L) - 1 - \frac{r_p}{2}(1-r) - C'_L\right] - C'_D$$

$$(4) \qquad r_T = \delta(.)(1+r_L) - 1 - C'_L$$

$$(5) \qquad r = 1 - \frac{\delta(.)(1+r_L) - 1 - C'_L}{r_p}$$

From equations (3) and (5) we obtain:

$$(6) \qquad r_D = \frac{\left[\delta(.)(1+r_L) - C'_L - 1\right]^2}{2r_p} - C'_D$$

where C'_L and C'_D are the operational marginal costs of loans and deposits, respectively. As in Freixas and Rochet (1997) and to simplify our analysis, these costs are assumed to be constant, so $C'_L = \gamma_L$ and $C'_D = \gamma_D$.

Equation (3) implies that a competitive bank chooses the optimal amount of deposits in such a way that the marginal net revenue (taking into account the credit risk)[18], $(1-r)\left[\delta(.)(1+r_L) - 1\right] - r_D$, must equal the marginal cost, which corresponds to the illiquidity and the operational costs[19], $(1-r)\left[\frac{r_p}{2}(1-r) + \gamma_L\right] + \gamma_D$.

Equation (4) states that the marginal revenue on government bonds, r_T, must equal their marginal opportunity cost (of not lending to private agents, taking into account the credit risk), $\delta(.)(1+r_L) - 1 - \gamma_L$. Finally, from equation (5), the optimal level of reserves depends on their opportunity cost (of not lending these resources to private agents), relative to the savings from not having to borrow them from the Central Bank, $\frac{\delta(.)(1+r_L) - 1 - \gamma_L}{r_p}$.

3.3 Equilibrium in the Deposit and Credit Markets

In order to close the model and find the equilibrium market rates, we put together the balance sheets of the banks and the equilibrium conditions for the Deposit and Credit markets. The competitive equilibrium is characterized then by equations (3)-(5) and the following conditions:

$$(7) \quad D = D^s\left(r_D, r_D^*, r_T, Y\right)$$

$$(8) \quad L = L^d\left(r_L, r_L^*, Y\right)$$

$$(9) \quad T = T^s - T_{-b}^d\left(r_D, r_D^*, r_T, Y\right)$$

$$(10) \quad D(1-r) = L + T$$

where:

- $D^s\left(r_D, r_D^*, r_T, Y\right)$ is the total supply of deposits by non-financial agents, which depends positively on the domestic deposit interest rate and income, and negatively on the foreign deposit interest rate and the return on government securities. It is assumed that these two types of assets are imperfect substitutes of domestic deposits.
- $L^d\left(r_L, r_L^*, Y\right)$ is the loan demand by non-financial agents in the economy, that depends negatively on the loan domestic interest rate and positively on the agents' level of income. It also depends positively on foreign loans
- T^s is the exogenous supply of securities by the government and $T_{-b}^d\left(r_D, r_D^*, r_T, Y\right)$ is the demand of these securities by other agents in the economy different from banks. It depends positively on the income and the own return, and negatively on the interest rate paid by domestic and foreign deposits, considered as imperfect substitutes of these securities.

Hence, in equilibrium:

$$(11) \quad L^d\left(r_L, r_L^*, Y\right) = (1-r)D^s\left(r_D, r_D^*, r_T, Y\right) - T^s + T_{-b}^d\left(r_D, r_D^*, r_T, Y\right)$$

The equilibrium deposit and loan interest rates are derived from equations (3), (4), (5) and (11), as implicit functions of the exogenous variables $r_L = r_L\left(r_p, r_L^*, r_D^*, T^s, Y, \gamma_L, \gamma_D\right)$ and $r_D = r_D\left(r_p, r_L^*, r_D^*, T^s, Y, \gamma_L, \gamma_D\right)$ These functions are potentially non-linear because they depend on the functional forms of the deposit supply and loan demand[20].

3.4 The Results

The comparative statics analysis of equations (3)-(5) and (11) allows us to appreciate the effects of shocks to the exogenous variables on deposit and loan interest rates (see Appendix A for the details).

Result 1: *The effect of a shift in the monetary policy interest rate, r on the equilibrium loan interest rate is positive. The effect of the same shift on the deposit interest rate is ambiguous.*

An increase in the policy interest rate makes the liquidity shortage more costly for banks. This has two implications. On the one hand, banks have more incentives to keep a higher level of reserves, implying a decrease in banks' loan supply or an increase in deposit demand. Hence, there is an upward pressure on loan and deposit interest rates. On the other hand, since the cost of illiquidity depends on the amount of deposits, the rise in policy rates makes deposits more expensive and reduces banks' demand for them. This pushes deposit rates down.

Result 2: *A change in the foreign interest rates or the expectations of depreciation has a positive effect on equilibrium loan and deposit interest rates.*

If the foreign interest rates or the expectations of depreciation rise, agents in the domestic economy perceive a higher cost of borrowing abroad, increasing their demand for domestic loans. Thus, domestic loan interest rates increase. The higher demand for loans makes banks raise their deposit demand at the same time that agents reduce their supply of deposits because foreign deposits are more attractive. Hence, deposit interest rates also increase.

Result 3: *The effect of a change in the income level on the equilibrium loan and deposit interest rates is ambiguous.*

An increase in income raises deposit supply and loan demand, implying a decline in the deposit rate and an increase in the loan rate. In order to satisfy the higher demand for loans, banks increase their demand for deposits, pushing deposit interest rates up. Additionally, given that credit risk is reduced by the agents' better conditions (a higher proportion of loans will be recovered), banks have incentives to increase their loan supply inducing a downward pressure on loan rates. As a result, the effect of the shift in income on market rates is ambiguous.

Result 4: *An increase in the government securities supply, T^s, implies a rise in the equilibrium level of loan and deposit interest rates.*

An additional supply of government securities competes with loans in banks' portfolios and with deposits in the agents' portfolios. This implies a reduction in the supply of deposits by firms and households, and a drop in the loan supply by commercial banks, increasing interest rates. This effect is reinforced if banks increase their demand for deposits to fund their purchases of government securities.

Notice that, in general, the response of market interest rates to the exogenous shocks may not be linear and could depend on macro variables affecting the elasticities of the loan supply and the demand for deposits. In other words, that response is complex and may depend on the state of the economy. Furthermore, it is possible that a shock to an exogenous variable has an impact on others. For example, an increase in the foreign interest rate may cause movements in the policy rate, the expectations of depreciation and output. Hence, the observed response of market rates to "a" shock may involve a reaction to movements in several variables.

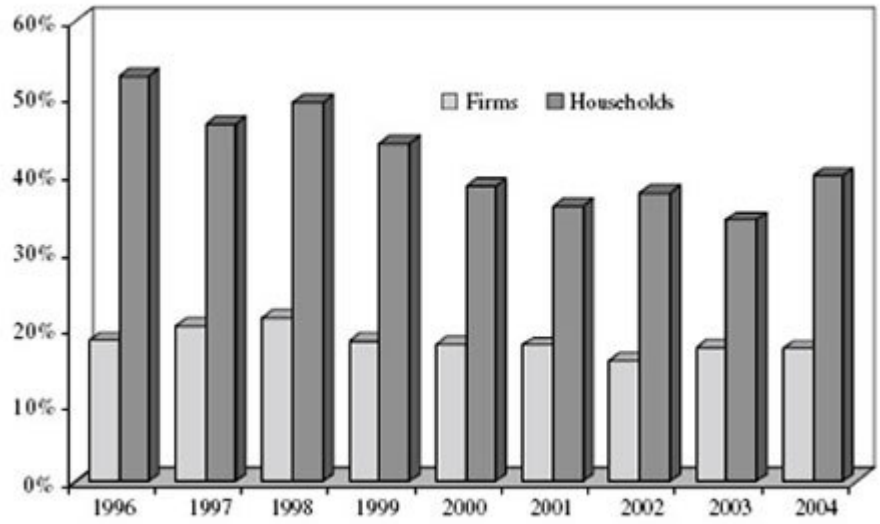
As a corollary, we conclude that there is a possibly complex relationship between policy and market interest rates. We also conclude that interest rate pass-through depends on the state of the economy and that its estimation must control for the presence of other shocks hitting the financial markets.

4. EMPIRICAL EVIDENCE FOR COLOMBIA

The literature for Colombia has shown that the importance of substitutes for loans in banks' and firms' balance sheets has increased since 2000 (Huertas *et at,* 2005 and Zamudio and Martinez, 2006). This change may reflect the adjustment made by agents after the financial crisis and the recession of 1998-1999, and not necessarily a structural change. A reduction of the loan supply might have been due to the higher risk perception of the economy by the financial system after the crisis, and a decrease in loan demand could have occurred because of an explicit policy of leverage reduction by firms and households.

However, bank loans and deposits remain an important component of private sector liabilities and assets. According to the flow of funds accounts, financial debt funded on average 42% of the households' and small firms' total assets during the period 1996-2004[21]. This proportion fell after the recession, but has recovered in recent years (Figure 1). Further, the proportion of small firms' and households' total assets held as deposits in the financial system was on average 42%, for the same period. This evidence suggests that the banking sector plays a relevant role as a provider of funds and as a deposit system for the private sector in the Colombian economy[22].

FIGURE 1
PRIVATE SECTOR FINANCIAL DEBT AS PERCENTAGE OF TOTAL ASSETS

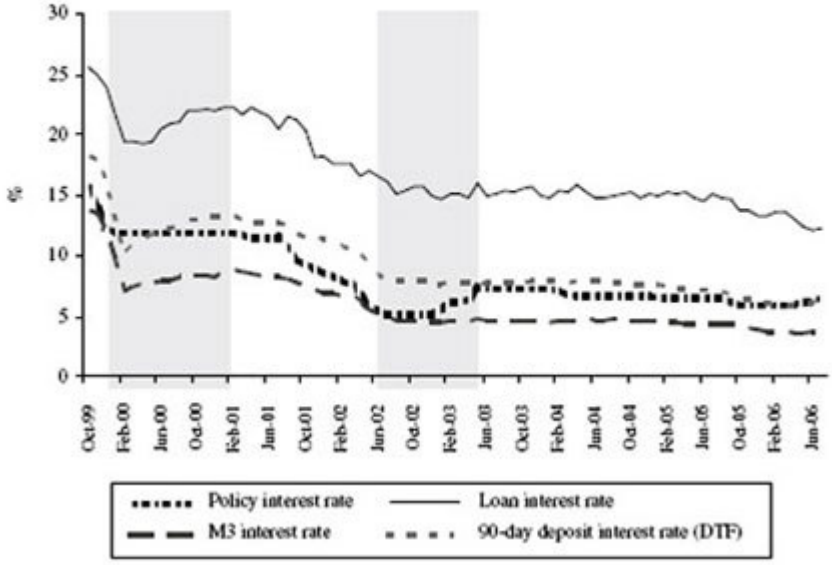


Source: Banco de la República.

For this reason, financial system (loan and deposit) interest rates are important components of the transmission mechanism of monetary policy in Colombia. In this context, the model developed above suggests that the study of the effects of macroeconomic variables on deposit and loan markets is especially relevant. In particular, changes in country risk perceptions, banks' holdings of Government securities or in the loan portfolio quality could explain the dynamics of market and policy rates[23] and their divergence during the periods January 2000-February 2001 and July 2002-May 2003 in Colombia (Figures 2 and 3).

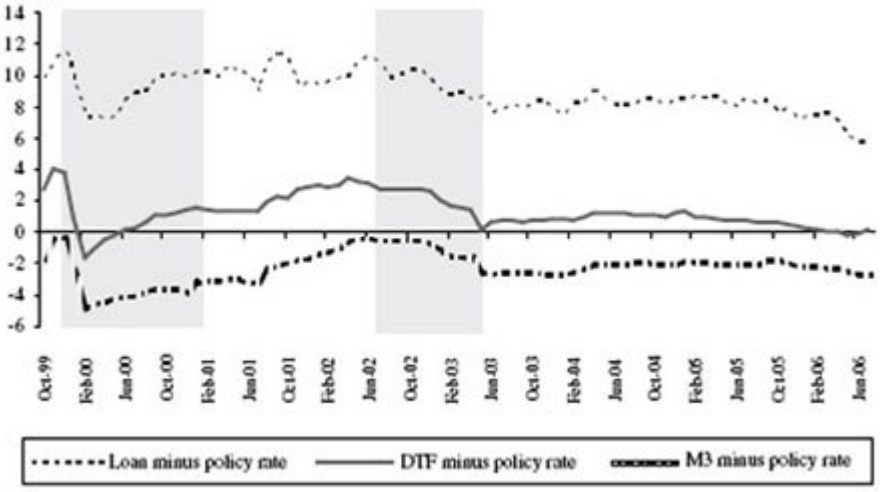
FIGURE 2
NOMINAL INTEREST RATES IN COLOMBIA

a) Interest rates in percentage



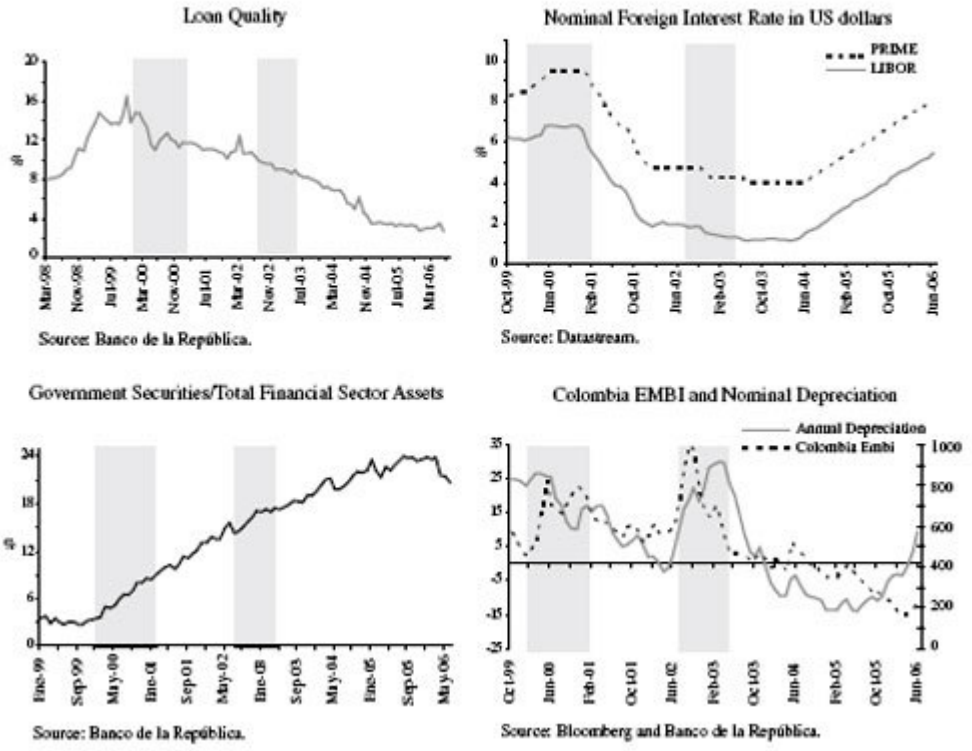
Source: Banco de la República.

b) Differential between market and policy interest rates



Source: Banco de la República.

FIGURE 3
MACROECONOMIC VARIABLES ON DEPOSITS AND LOAN MARKETS



4.1 Econometric Evidence

The theoretical model developed previously implies that market interest rates are affected by factors other than the policy rate. Therefore, the estimation of interest rate pass-through must control for movements in other macroeconomic variables, which may impact the loan and deposit markets equilibrium.

Using the Colombian data for the period June 1999-August 2006 we test this hypothesis following two approaches. First, we assume the existence of a long run relationship between market and policy interest rates. Then we estimate uni-equational error correction models for the market rates, in which other macro variables suggested by the theoretical model are included as explanatory variables of the short run dynamics.

In the second approach we acknowledge that some of the macro explanatory variables may be endogenous in a general equilibrium context. Hence, we estimate a VARX, perform Granger causality tests for the market interest rate equation to verify the significance of the macro variables in determining its dynamics, and examine the impulse response functions to check the direction of the market interest rate reaction to different shocks.

Uni-equational Error Correction Models

Assuming a long run relationship between market and policy interest rates, we estimate uni-equational error correction models for two different measures of the deposit interest rate, a weighted average of the 90-day CDs interest rates (DTF) and a weighted average of the interest rates for different types of deposits (M3). The short run dynamics is modeled using the EMBI, the foreign interest rate (LIBOR), the industrial production index (as a measure of output) and the

nominal depreciation as explanatory variables (For the description of the variables see Appendix C).

Tables 1 and 2, show the estimations of two different models for each measure of the deposit interest rate. The first model takes as explanatory variables the EMBI, the LIBOR and the policy interest rate, which can be assumed to be exogenous in a more general model. The second model also includes the nominal depreciation and the industrial production index (IPI) as exogenous variables, although they can be endogenous in a more general setting. In most cases, variables different from the policy interest rate and the residual of the long run equation[24] are significant in the error correction equations and the signs are those predicted by the theory, with the notable exception of the foreign interest rate.

TABLE 1
UNI-EQUATIONAL ERROR CORRECTION MODELS FOR CHANGES IN THE 90-DAY DEPOSIT INTEREST RATE

	Model 1*	Model 2**
CONSTANT	0.012486 (0.028915)	–0.004822 (0.035653)
RESIDUAL(–1)	–0.090749) (0.032698	–0.113041 (0.039219)
ΔDTF(–1)	0.353508 (0.050620)	0.373285 (0.065021)
ΔDTF(–3)	–0.337037 (0.068764)	
ΔDTF(–5)	0.217546 (0.064727)	
ΔDTF(–6)	–0.216093 (0.055857)	
ΔPOLICY(–1)	0.446948 (0.107361)	0.640457 (0.126274)
ΔPOLICY(–5)	0.468927 (0.111004)	
ΔEMBI(–1)	0.161678 (0.046328)	0.094241 (0.057953)
ΔEMBI(–2)	0.164808 (0.050896)	
ΔEMBI(–4)	0.200096 (0.047136)	
ΔLIBOR(–3)	–0.449696 (0.121258)	–0.356040 (0.156003)
ΔDEPRECIATION(–2)		0.005335 (0.002612)
ΔIPI(–5)		–1.514 (0.782946)
ΔITES(–4)		
R-squared	0.854	0.745
Adjusted R-squared	0.831	0.721
S.E. of regression	0.215	0.291
Sum squared resid	3.147	6.248
Log likelihood	15.949	–10.805
Durbin-Watson stat	2.268	1.820
Akaike info criterion	–0.099	0.459
Schwarz criterion	0.259	0.693
F-statistic	36.245	30.890

Standard error in parenthesis.

* This model does not consider variables which can be endogenous.
Sample 2000:01 - 2006:08. Included observations: 80 after adjustments.

** This model includes other variables that can be endogenous in a more general model.
Sample 1999:11 - 2006: 08. Included observations: 82 after adjustments

TABLE 2
UNI-EQUATIONAL ERROR CORRECTION MODELS
FOR CHANGES IN THE M3 INTEREST RATE

	Model 1*	Model 2**
CONSTANT	0.000408 (0.032130)	–0.010530 (0.028778)
RESIDUAL(–1)	–0.089990 (0.044198)	–0.111004 (0.040513)
ΔPOLICY(–1)	0.265058 0.116803	0.245400 (0.107855)
ΔPOLICY(–2)	0.632620 (0.106224)	0.578453 (0.098401)
ΔEMBI(–1)	0.131270 (0.049625)	
ΔEMBI(–4)	0.155397 (0.048852)	0.141503 (0.050822)
ΔLIBOR(–4)		–0.418220 (0.120513)
ΔDEPRECIATION(–1)		0.007988 (0.002161)
ΔDEPRECIATION(–4)		0.005280 (0.002380)
R-squared	0.687	0.754
Adjusted R-squared	0.667	0.730
S.E. of regression	0.253	0.228
Sum squared resid	4.858	3.831
Log likelihood	–0.484	9.250
Durbin-Watson stat	1.506	1.525
Akaike info criterion	0.158	–0.030
Schwarz criterion	0.334	0.204
F-statistic	33.457	32.339

Standard error in parenthesis
* This model does not consider variables which can be endogenous.
Sample 1999:11 - 2006:08. Included observations: 82 after adjustments.
** This model includes other variables that can be endogenous in a more general model.
Sample 1999:11 - 2006: 08. Included observations: 82 after adjustments.

The results show that the most important variable in the determination of the deposit interest rate, in terms of the short run effect, is the policy rate. The sum of the policy rate coefficients in the EC equation is 0.92 for the DTF and 0.90 for the M3 interest rate in the first model. However, when the industrial production is introduced in the second model, this variable has the biggest effect on the DTF and the effect of the policy rate is reduced to 0.64. Although, the IPI is not significant for the M3 interest rate the effect of the policy rate decreases to 0.82 in the second model because of the existence of other explanatory variables.

The significance of the estimated coefficients for the macro variables, other than the policy rate, indicates their importance in the determination of the deposit rates. For example, in the first model an increase of 100 basis points (b.p.) in the EMBI produces an increase of 53 b.p. in the DTF and of 30 b.p. in the M3 interest rate, as expected in the theoretical model[25]. Also, an increase of 1 % in the IPI implies a decrease of 1.5% in the DTF, meaning that the rise in the deposit supply due to a higher agents' income compensates the additional banks' demand for deposits to satisfy a higher demand for loans. On the other hand, although the coefficient of the foreign interest rate is significant, its sign is not as expected, indicating that there is an effect not explained by the theoretical model.

The cumulative impulse-response functions (Figures 4 and 5) show that the long

run pass-through from the policy rate to the DTF is complete in both models. However, this pass-through is incomplete for the M3 interest rate (the long run response of the M3 rate to a change in the policy rate is less than one).

FIGURE 4
ERROR CORRECTION IMPULSE-RESPONSE FUNCTIONS
FOR THE DEPOSITS INTEREST RATE (DTF)

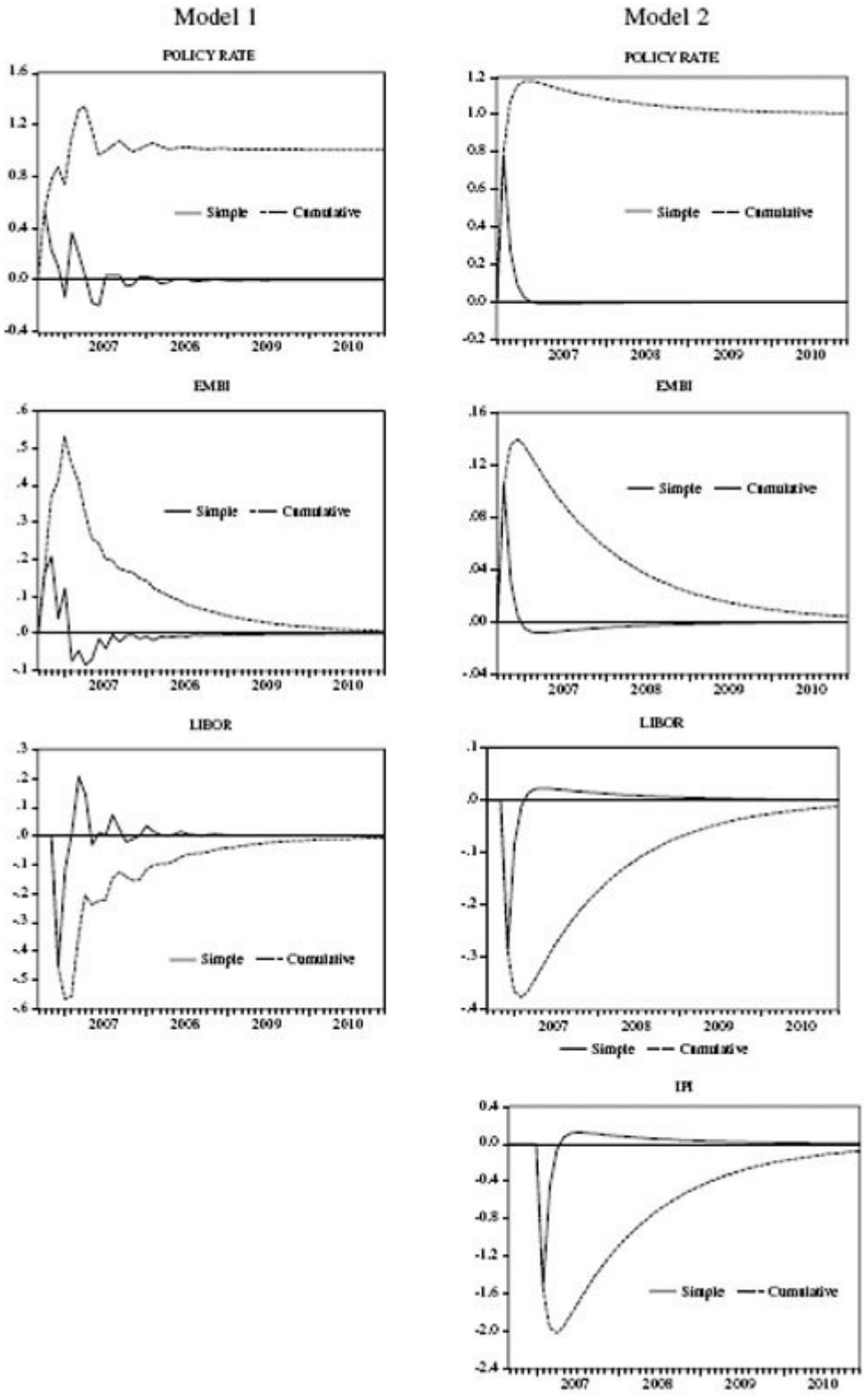
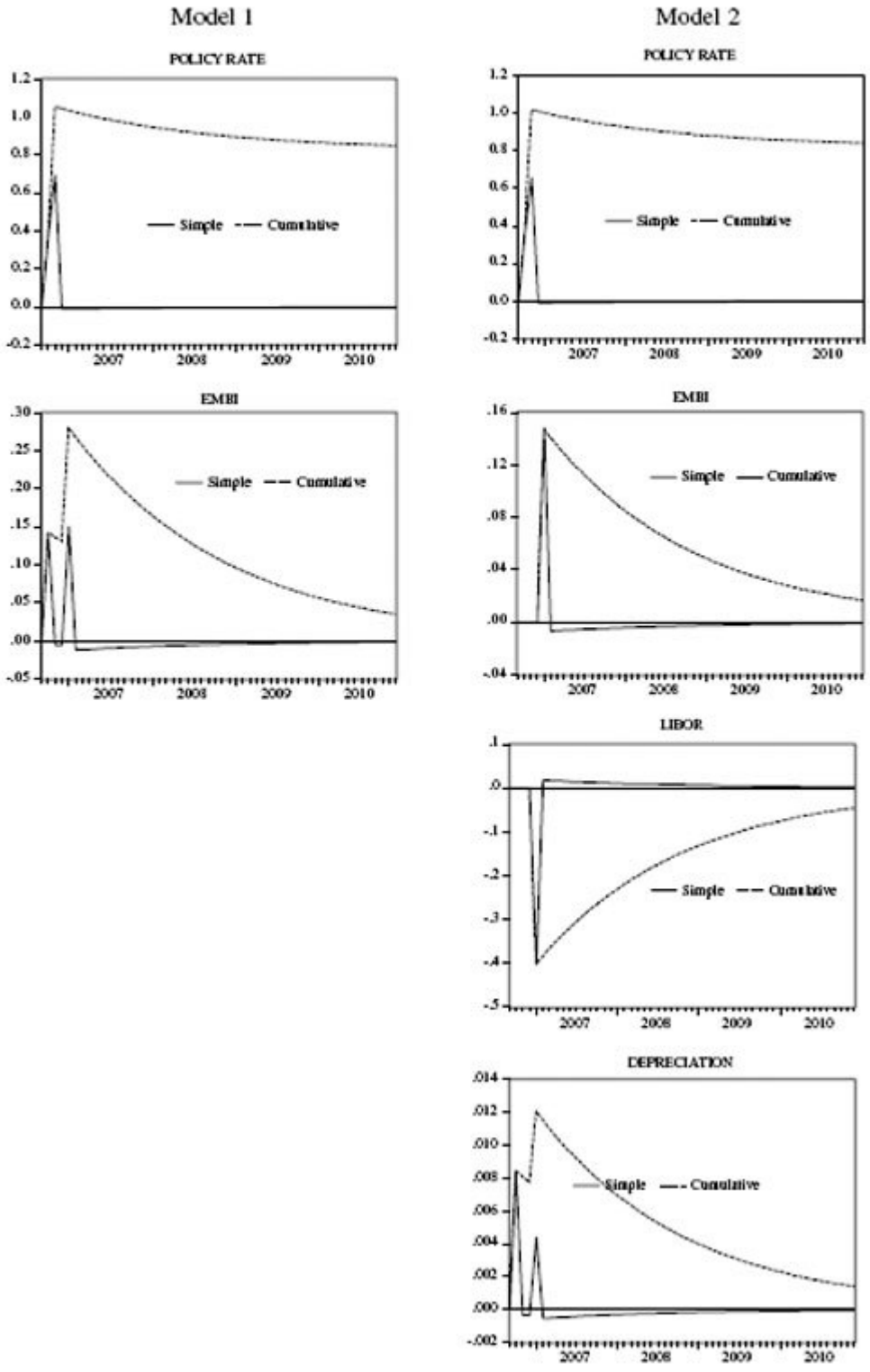


FIGURE 5
ERROR CORRECTION IMPULSE-RESPONSE FUNCTIONS
FOR THE M3 INTEREST RATE



The previous results imply that the short run interest rate pass-through to the deposit rate is incomplete but that the long run pass-through is complete at least for the DTF. Moreover, these results show that the introduction of some macroeconomic variables reduces the impact of the policy rate on the deposit rate, given their significance in the explanation of the market interest rates behavior.

VARX models

To assess the impact of exogenous shocks on deposit interest rates, one must take into account not only their direct effect, but also the indirect effects that occur through other macro variables that are endogenous in a general equilibrium context, such as the exchange rate and the output. There may be also feed-back from market rates themselves to those macro endogenous variables. To capture the richer dynamics implied by the argument above, we estimate VARX models for a set of variables in first differences. We assume that the EMBI, the foreign interest rates (the LIBOR) and the policy rates are exogenous variables, while deposit rates, inflation, nominal depreciation and our measure of output are treated as endogenous.

In order to verify our hypothesis, we check the significance of variables other than the policy rate in the deposit rate equation by means of Granger causality tests. Tables 3 and 4 show these tests for two specifications of VARX that include the DTF or the M3 interest rate, respectively[26]. According to the equation for the DTF, the policy rate, the nominal depreciation, the EMBI and the LIBOR Granger-cause this deposit rate. Also, the policy rate, the inflation, the nominal depreciation, the EMBI and the LIBOR Granger-cause the M3 deposit rate.

TABLE 3
GRANGER CAUSALITY TESTS ON DEPOSITS INTEREST RATE (DTF)

Null Hypothesis	Test-value	Probability
ΔDEPRECIATION not Granger cause DDTF	31.01	0.0001
ΔIPI not Granger cause DDTF	4.70	0.5825
ΔINFLATION not Granger cause DDTF	7.30	0.2938
ΔEMBI not Granger cause DDTF	32.42	0.0001
ΔPOLICY not Granger cause DDTF	98.35	0.0001
ΔLIBOR not Granger cause DDTF	12.77	0.0778

Note: The estimated VARX model uses 6 lags for the endogenous and exogenous variables.

TABLE 4
GRANGER CAUSALITY TESTS ON M3 INTEREST RATE

Null Hypothesis	Test-value	Probability
ΔDEPRECIATION not Granger cause DM3	25.07	0.0003
ΔIPI not Granger cause DM3	8.43	0.2086
ΔINFLATION not Granger cause DM3	16.70	0.0104
ΔEMBI not Granger cause DM3	26.28	0.0004
ΔPOLICY not Granger cause DM3	99.74	0.0001
ΔLIBOR not Granger cause DM3	15.50	0.0301

Note: The estimated VARX model uses 6 lags for the endogenous and exogenous variables.

From the cumulative impulse-response functions of the VARX models, we examine the impact of some shocks on the two measures of deposit rates (Figures 6 and 7). These functions show a large (higher than one) long run reaction of the market interest rates to policy rate shocks. In this context, this response may be regarded as an appropriate measure of the long-run interest rate pass-through, since most direct and indirect effects are taken into account.

FIGURE 6
CUMULATIVE IMPULSE-RESPONSE FUNCTIONS
FOR THE DTF EQUATION (IN LOGS)

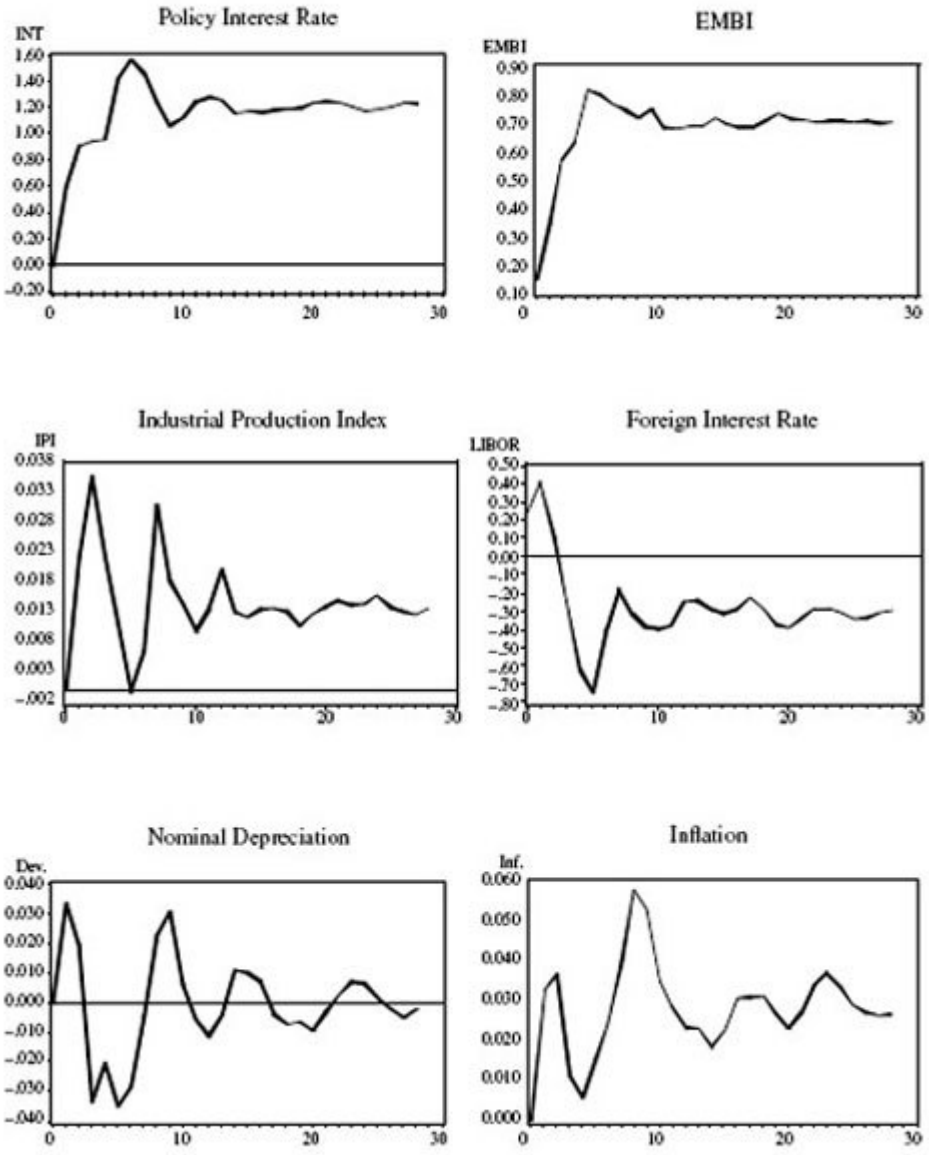
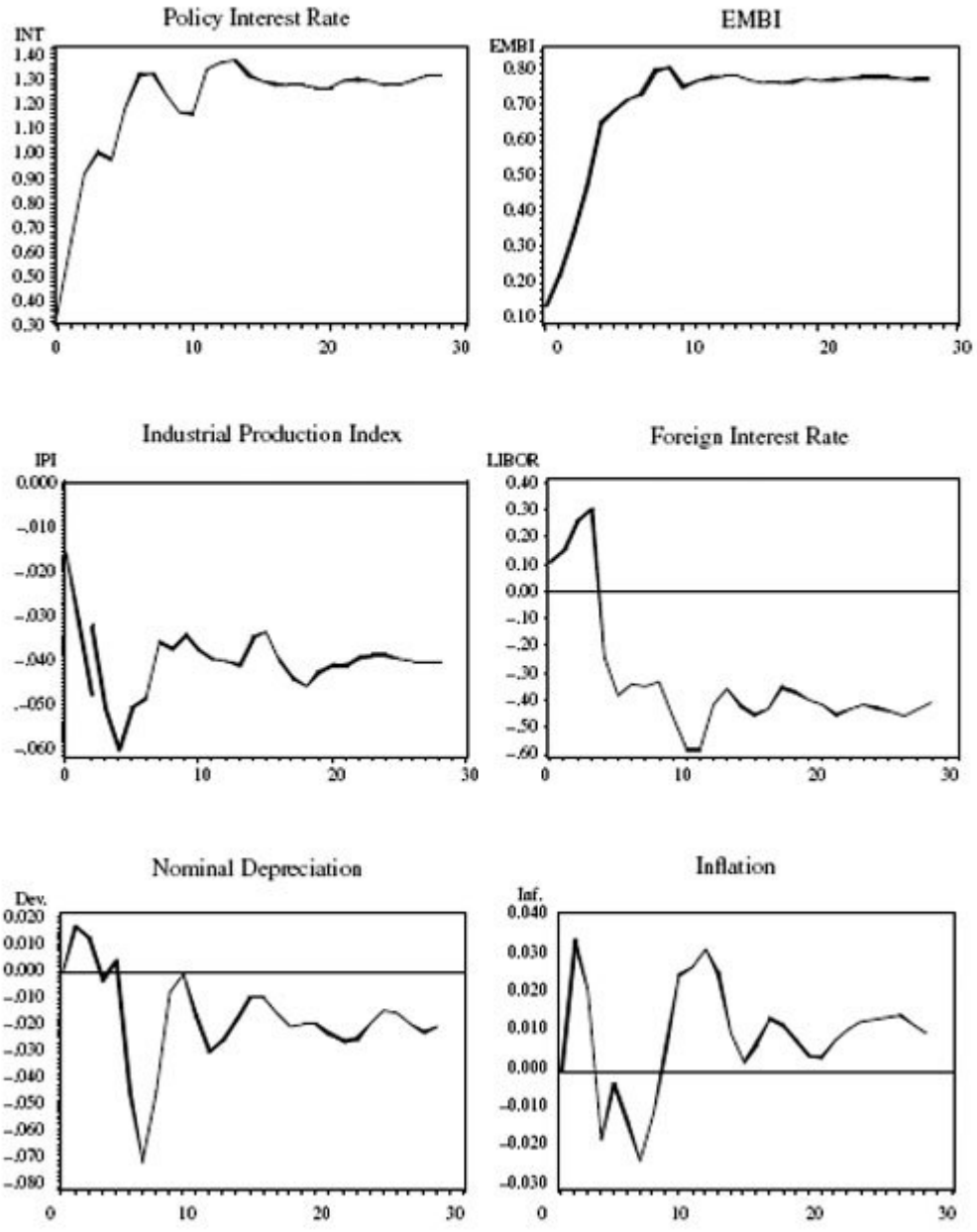


FIGURE 7
CUMULATIVE IMPULSE-RESPONSE FUNCTIONS
FOR THE M3 INTEREST RATE EQUATIONS (IN LOGS)



For other shocks, the market interest rates long-run response is in agreement with the theoretical model with the exception of the LIBOR, whose effect is counter-intuitive. In particular, the EMBI has the second highest effect on the deposit rates, after the effect of the policy rate, and the IPI has an ambiguous effect depending on the measure of the deposit rate.

5. CONCLUSIONS

In contrast to the standard approach to monetary policy, which considers the banking sector as a passive aggregate, this paper shows the implications of modeling commercial banks as independent entities that optimally react to their environment. Based on a theoretical microeconomic model of the banking firm and the credit and deposits markets, we illustrate the idea that the response of

market interest rates to changes in the policy interest rate may be a complex process that depends on the macroeconomic variables comprising the state of the economy.

Given these theoretical results, we argue that the estimation of interest rate pass-through must control for the variables affecting the financial system and the behavior of banks. The results from uni-equational error correction and VARX models for the Colombian data seem to support our hypotheses. These estimations imply that the short run interest rate pass-through to the deposit rate is incomplete while in the long run the transmission of a change in the policy rate is complete. Furthermore, these results show the significance of other macroeconomic variables different from the policy rate on the dynamics of different measures of the deposit interest rate, as suggested by the theoretical model developed above.

Finally, a policy implication follows immediately from the previous arguments and results. The Central Bank's policy decision should take into account the direct effects of macro variables on market rates and consider the complex relationship between policy and market rates. If these factors are empirically relevant, a failure by the Central Bank to include them in its reaction function may increase the risk of missing its targets and/or may introduce excessive volatility to interest rates and output. The importance for the Central Bank of the role of banks and financial markets in the interest rate pass-through can be understood by means of a small-open economy macro model that includes a version of our micro-banking model. This is the matter of future research.

NOTES

* The opinions expressed in this paper are those of the authors and do not represent the views of the Banco de la República or of its Board of Directors. We thank the anonymous referees for helpful comments. Email: ybetanga@banrep.gov.co.

[1]See Loayza and Schmidt-Hebbel (2002) for an overview about the transmission mechanisms.

[2]The importance of the banking sector in the interest rate pass-through is theoretically studied by Hannan and Berger (1991) and empirically assessed by Cottarelli and Kourelis (1994). For an overview of the banking industry and monetary policy literature see Ahumada and Fuentes (2004).

[3]In contrast to the classical monetarist view that emphasizes the role of narrow and broad monetary aggregates in determining prices.

[4]Cottarelli and Kourelis (1994) consider the *financial structure* as a term that broadly includes different features such as the degree of development of financial markets, the degree of competition within the banking system, the existence of constraints on capital movements and the ownership structure of the financial intermediaries.

[5]According to Cottarelli and Kourelis (1994) *interest rate stickiness* means that in the presence of a change of money market rates, bank rates change by a smaller amount in the short run (short-run stickiness) and possibly also in the long run (long-run stickiness).

[6]This principle states that nominal interest rates have to respond at least one-for-

one to changes in the expected inflation rate to guarantee a stable and unique equilibrium.

[7]The authors also use VAR models in differences in order to see the impact of the interbank interest rate on the 90-day CDs interest rate (DTF).

[8]The short run corresponds to one week and the long-run elasticity was calculated as an average of the change in the interest rates between movements in policy rates during the period from March 2001 to December 2004.

[9]The authors analyze a sample of 3.585 financial-statement-reporting firms.

[10]According to the authors the proportion of the private credit on the banks' total assets was 85% in 1994 and 65% in 2004, while the banks' public investments as a proportion of the total assets increased from 7% to 27% during the same period.

[11]This is in agreement with the results of Zamudio and Martinez (2006), who find that firms decreased their debt with the financial sector in 2005 and internal savings were their main source of funds (52% in contrast to 48% of external resources).

[12]In contrast to Freixas and Rochet (1997), there are no additional deposits.

[13]If firms and households have good economic conditions, they can repay their loans with higher probability.

[14]This can be interpreted in two ways. First, an increase in the loan interest rate implies a higher cost of resources for agents, causing a higher probability of default. The second interpretation follows Stiglitz and Weiss (1981) credit rationing argument, according to which an increase in the loan interest rate changes the risk of the population, either because agents take more risky projects or because less risky firms drop out of the market.

[15]This function is supposed to satisfy the usual conditions of convexity and regularity.

[16]They take as given the rate of loans, r_L, the rate of deposits, r_D, the return on government securities, r_T, and the policy rate, r .

[17]We assume that reserves do not have any return because we do not take into account the interbank market. It means that banks keep in cash their reserves and that they borrow only from the Central Bank at a cost r .

[18]This net income becomes from the possibility of lend a proportion (1 - r) of the deposits and pay interest on the total amount of deposits. It is necessary to take into account that there is a credit risk that not allows recovering all the loans granted and only a proportion of them pay interest.

[19]The illiquidity and the loan management costs depend on the proportion of deposits granted in loans.

[20]Also, these functions can be non-linear if the withdrawals have a non-uniform probability distribution.

[21]This figure is 18% for financial-statement-reporting firms in the same period.

[22]According to Villar *et al.* (2005), in 2001 the domestic private credit/GDP ratio (a measure of financial deepening) was 25% for Colombia, similar to the ratios for Argentina, Perú and Ecuador. This indicator was 65% for Chile, 97% for Thailand, 125% for China and 150% for Malaysia.

[23]The policy rate corresponds to the interest rate at which the Central Bank gives liquidity to the market by means of an auction, which is called *Subasta de Expansión.* The market interest rates are the lending and deposit rates. The first one is the average interest rate for all types of loans weighted by their volume. The second one can be measured by the DTF, which corresponds to the weighted average of the interest rates for the 90-day CDs, and by the M3 interest rate, which corresponds to the weighted average of the interest rates for different types of deposits.

[24]This residual is obtained from the estimation of the long run relationship between the policy and the deposit interest rate.

[25]However, when the depreciation and the industrial production index are introduced in the second model the effect of the EMBI is reduced to 9 b.p. on the DTF and to 14 b.p. on the M3 rate.

[26]There may exist a bias in the estimation because we are not taking into account the long run relationship between market and policy interest rates and other long run relations between the variables included in the VARX. A method that allows to estimate the correct long and short run relationships is a VEC, but the sample is too short to use this technique.

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APPENDIX A
THE MICRO-BANKING MODEL

A. 1. Effect of a marginal shift in the monetary policy interest rate:

Differentiating equation (10) with respect to r_p yields the following result:

$$(A1)\quad \frac{dr_L}{dr_p}=\frac{\frac{\partial r_D}{\partial r_p}\left[(1-r)\frac{\partial D^r}{\partial r_D}+\frac{\partial T^d_{-b}}{\partial r_D}\right]-D^r(.)\frac{\partial r}{\partial r_p}}{\frac{\partial L^d}{\partial r_L}-\frac{\partial r_D}{\partial r_L}\left[(1-r)\frac{\partial D^r}{\partial r_D}+\frac{\partial T^d_{-b}}{\partial r_D}\right]-\frac{\partial r_T}{\partial r_L}\left[(1-r)\frac{\partial D^r}{\partial r_T}+\frac{\partial T^d_{-b}}{\partial r_T}\right]+D^r(.)\frac{\partial r}{\partial r_L}}$$

(i) $\frac{\partial r_D}{\partial r_p}=-\frac{\left[\delta(.)(1+r_L)-\gamma_L-1\right]^2}{2r_p^2}<0$ is the *direct* impact of the policy rate on the deposit rate. This effect is negative because a higher policy rate implies a higher illiquidity cost and, as the withdrawals depend on the amount of deposits, banks will demand deposits only at lower deposit rates.

(ii) $\frac{\partial r_T}{\partial r_L}=\delta(.)+(1+r_L)\frac{\partial \delta}{\partial r_L}$ is the impact of the loan interest rate on the government securities return, which is ambiguous because a positive shift in loan interest rates implies an increase in the credit risk, $\frac{\partial \delta}{\partial r_L}<0$. However, if the economic conditions are good, the proportion of recovered loans $\delta(.)$ can be sufficiently high to compensate the increasing credit risk, so that, $\frac{\partial r_T}{\partial r_L}$ will be positive. Intuitively, $\delta(.)+(1+r_L)\frac{\partial \delta}{\partial r_L}$ is the bank's marginal revenue derived from an increase in r_L. If it is positive, banks will increase loans, demand less government bonds and the price of the latter will fall (r_T will go up).

(iii) $\frac{\partial r}{\partial r_L}=-\frac{\left[\delta(.)+(1+r_L)\frac{\partial \delta}{\partial r_L}\right]}{r_p}$ is the impact of the loan interest rate on the banks' fraction of reserves It is also ambiguous and depends on credit risk. As before, if the increase in credit risk is smaller than the recovered proportion of loans, this effect is negative. Intuitively, if the bank's revenues increase with the rise in r_L, banks will lend more and reduce reserves.

(iv) $\frac{\partial r_D}{\partial r_L} = \frac{\left(\delta(.)(1+r_L)-\gamma_L-1\right)\left(\delta(.)+(1+r_L)\frac{\partial \delta}{\partial r_L}\right)}{r_T}$ is the impact of loan interest rate on deposit rates. From equation (4), we know that $\left(\delta(.)(1+r_L)-\gamma_L-1\right)$ is positive if there are positive returns on government securities. Additionally, as before, if $\left[\delta(.)+(1+r_L)\frac{\partial \delta}{\partial r_L}\right]>0$, then $\frac{\partial r_D}{\partial r_L}>0$. Intuitively, if the bank's revenues increase with the rise in r_L, they will demand more deposits inducing an upward pressure on r_D.

(v) $\frac{\partial r}{\partial r_T} = \frac{\left(\delta(.)(1+r_L)-\gamma_L-1\right)}{r_T^2}$ is the *direct* impact of the policy rate on the proportion of reserves, which is positive if $r_T>0$. If the policy rate increases, the illiquidity cost goes up, and banks prefer to keep a higher proportion of deposits as reserves.

Finally, $\frac{dr_L}{dr_T}$ is positive if $\left[\delta(.)+(1+r_L)\frac{\partial \delta}{\partial r_L}\right]>0$ and the own elasticity on the demand for deposits (demand for government securities) is greater than the cross-elasticity with respect to the return on government securities (the deposit interest rate), namely, $\frac{\partial D^d}{\partial r_D}>\frac{\partial T^d_{-k}}{\partial r_D}$ and $\frac{\partial D^d}{\partial r_T}<\frac{\partial T^d_{-k}}{\partial r_T}$. Thus we suppose that agents react more to the own returns of each asset than to the return of alternative assets.

The impact of a change in the policy rate on the deposit interest rate depends on the direct effect, which is negative, and the effect through the loan rate, which is positive. Then, the final effect is ambiguous.

A.2. Effect of a marginal change in the foreign interest rates

Differentiating equation (10) with respect to r^*_L and r^*_D yields the following results:

(A.2) $$\frac{dr_L}{dr^*_L} = \frac{-\frac{\partial L^d}{\partial r^*_L}}{\frac{\partial L^d}{\partial r_L}-\frac{\partial r_D}{\partial r_L}\left[(1-r)\frac{\partial D^d}{\partial r_D}+\frac{\partial T^d_{-k}}{\partial r_D}\right]-\frac{\partial r_T}{\partial r_L}\left[(1-r)\frac{\partial D^d}{\partial r_T}+\frac{\partial T^d_{-k}}{\partial r_T}\right]+D^d(.)\frac{\partial r}{\partial r_L}}$$

$$\frac{dr_L}{dr_D^*} = \frac{(1-r)\frac{\partial D^s}{\partial r_D^*} + \frac{\partial T_{-b}^d}{\partial r_D^*}}{\frac{\partial L^d}{\partial r_L} - \frac{\partial r_D}{\partial r_L}\left[(1-r)\frac{\partial D^s}{\partial r_D} + \frac{\partial T_{-b}^d}{\partial r_D}\right] - \frac{\partial r_T}{\partial r_L}\left[(1-r)\frac{\partial D^s}{\partial r_T} + \frac{\partial T_{-b}^d}{\partial r_T}\right] + D^s(.)\frac{\partial r}{\partial r_L}} \quad \text{(A3)}$$

where $\frac{\partial r_D}{\partial r_L}$, $\frac{\partial r_T}{\partial r_L}$ and $\frac{\partial r}{\partial r_L}$ are explained and signed above. The signs of these two expressions depend again on the assumptions about the elasticities. If we assume that the direct elasticities are higher than the cross-elasticities, then the impact of a change in the foreign interest rates is positive on the loan and deposit interest rates.

A.3. Effect of a marginal shift in the level of income:

(A4)

$$\frac{dr_L}{dY} = \frac{-\frac{\partial L^d}{\partial Y} + \frac{\partial r_D}{\partial Y}\left[(1-r)\frac{\partial D^s}{\partial r_D} + \frac{\partial T_{-b}^d}{\partial r_D}\right] + \frac{\partial r_T}{\partial Y}\left[(1-r)\frac{\partial D^s}{\partial r_T} + \frac{\partial T_{-b}^d}{\partial r_T}\right] + (1-r)\frac{\partial D^s}{\partial Y} - D^s(.)\frac{\partial r}{\partial Y} + \frac{\partial T_{-b}^d}{\partial Y}}{\frac{\partial L^d}{\partial r_L} - \frac{\partial r_D}{\partial r_L}\left[(1-r)\frac{\partial D^s}{\partial r_D} + \frac{\partial T_{-b}^d}{\partial r_D}\right] - \frac{\partial r_T}{\partial r_L}\left[(1-r)\frac{\partial D^s}{\partial r_T} + \frac{\partial T_{-b}^d}{\partial r_T}\right] + D^s(.)\frac{\partial r}{\partial r_L}}$$

where:

(i) $\frac{\partial r_D}{\partial Y} = \frac{(\delta(.)(1+r_L)-\gamma_L-1)(1+r_L)}{r_p}\frac{\partial \delta}{\partial Y}$ is positive, because an increase in the level of income improves the credit risk perception of banks and induce them to demand more deposits.

(ii) $\frac{\partial r_T}{\partial Y} = (1+r_L)\frac{\partial \delta}{\partial Y}$ is positive because $\frac{\partial \delta}{\partial Y} > 0$. An increase in the level of income improves the credit risk perception of banks, induce them to grant more loans and to reduce their demand for government securities. Thus, the return of these bonds must increase (their prices must fall).

(iii) $\frac{\partial r}{\partial Y} = -\frac{(1+r_L)}{r_p}\frac{\partial \delta}{\partial Y}$ is negative. If the output increases, credit risk is lower and banks prefer to grant more loans and keep less reserves.

Although the previous assumptions about the elasticities are made, $\frac{dr_L}{dY}$ is ambiguous, because agents are going to demand more credit, $\frac{\partial L^d}{\partial Y} > 0$, at the same time that banks grant more loans. The final impact on the deposit rate is also ambiguous, because agents with higher income supply more deposits $\frac{\partial D^s}{\partial Y} > 0$, while banks increase their demand for deposits.

A.4. Effect of a marginal shift in the government securities supply

Differentiating equation (10) with respect to T^S yields the following results:

$$\frac{dr_L}{dT^s} = \frac{-1}{\frac{\partial L^d}{\partial r_L} - \frac{\partial r_D}{\partial r_L}\left[(1-r)\frac{\partial D^r}{\partial r_D} + \frac{\partial T^d_{-b}}{\partial r_D}\right] - \frac{\partial r_T}{\partial r_L}\left[(1-r)\frac{\partial D^r}{\partial r_T} + \frac{\partial T^d_{-b}}{\partial r_T}\right] + D^r(.)\frac{\partial r}{\partial r_L}} \quad \text{(A.5)}$$

where $\frac{\partial r_D}{\partial r_L}$, $\frac{\partial r_T}{\partial r_L}$ and $\frac{\partial r}{\partial r_L}$ were explained and signed above. The same assumptions about elasticities imply that $\frac{dr_L}{dT^s} > 0$. If $\frac{\partial r_D}{\partial r_L} > 0$ then $\frac{dr_D}{dT^s} > 0$.

APPENDIX B

In this appendix we show some econometric results. First we show the results of unit root tests for the interest rates. Then the estimated long-run relationship between policy and market interest rates is shown.

B.1. Unit Root Tests

We carry out two unit root tests, the Augmented Dickey Fuller and the KPSS, in order to check the non-stationarity of the interest rates (Table 5). The Augmented Dickey Fuller test does not reject the null hypothesis of a unit root for the DTF at all significance levels. For the M3 this hypothesis is not rejected at 1 % of significance. The test for the policy rate shows that the unit root hypothesis is not rejected at 1% and 5%[27]. For the three interest rates, the KPSS test rejects the null hypothesis that each variable is stationary at all levels of significance. We can conclude from these results that the analyzed interest rates are 1(1).

TABLE 5
UNIT ROOT TESTS

	Augmented Dickey-Fuller Test Ho: variable has a unit root				KPSS Test Ho: variable is stationary			
	Test statistic	Critical Values			Test statistic	Critical Values		
		1%	5%	10%		1%	5%	10%
DTF (1)	–1.047	–3.517	–2.899	–2.587	1.050	0.739	0.463	0.347
M3 interest rate	–3.407	–3.510	–2.896	–2.585	1.096	0.739	0.463	0.347
Policy interest rate (3)	–2.774	–3.511	–2.896	–2.586	0.928	0.739	0.463	0.347

(1) 9 Lags used to get white noise residuals.
(2) 2 Lags used to get white noise residuals.
(3) 3 Lags used to get white noise residuals.

B.2. Long Run Relationship

The estimated long-run relationship between the policy rate and the deposit interest rates is shown in Table 6. The unit root tests show that the residual of the equation for the DTF is stationary at 5% and 10%, with the Engle-Yoo critical

values. The residuals of the equation for the M3 interest rate do not present a unit root according to the Engle-Yoo (1987) critical values at all significance levels. These results imply that there is a cointegration between the deposit interest rates and the policy rate because these variables are 1(1) and the residuals are 1(0).

TABLE 6
LONG RUN EQUATIONS

Dependent Variables

	DTF (1)	M3 (2)
Constant	1.132	–0.777980
	(0.345)	(0.271)
Policy Rate	1.003	0.822
	(0.037)	(0.029)
Test Statistic*	–2.575	–3.075
	Engle Yoo Critical Values**	
1%	5%	10%
2.60	1.95	1.61

* Ho: existence of a unit root.
** Critical values for a sample of 100 observations and non-constant.
(1) 3 Lags used in the residual test to get white noise.
(2) Lags = 3 used in the residual test to get white noise.

APPENDIX C

The description of the variables used in the econometric exercise is given in the fellowing table 7.

TABLE 7
DESCRIPTION OF THE VARIABLES

Variable	Definition	Sample	Frequency	Source
ΔDTF	Difference of the nominal 90-day deposit interest rate	June 1999 August 2006	Monthly	Banco de la República
ΔM3 (1)	Difference of the nominal average deposit interest rate	June 1999 August 2006	Monthly	Banco de la República
ΔPOLICY	Difference of the nominal policy interest rate "Subasta de Expansión"	June 1999 August 2006	Monthly	Banco de la República
ΔDEPRECIATION	Difference of the nominal annualized quarterly depreciation (Domestic currency/ Foreign currency)	June 1999 August 2006	Monthly	Banco de la República
ΔINFLATION	Difference of the consumer annual inflation	June 1999 August 2006	Monthly	DANE
ΔIPI	Logarithmic difference of the deseasonal industrial production index	June 1999 August 2006	Monthly	DANE
				Authors
ΔEMBI	Difference of the EMBI Colombia	June 1999 August 2006	Monthly	Bloomberg
ΔLIBOR (2)	Difference of the nominal LIBOR in dollars.	June 1999 August 2006	Monthly	Datastream

(1) The M3 interest rate corresponds to the average of the interest rates for different types of deposits (saving accounts, 90-day CDs and 360-day CDs) weighted by their volume.
(2) LIBOR (London Interbank Offer Rate) is the interest rate for 3-month deposits in dollars.

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Economic Reforms, Financial Development and Growth: Lesso from the Chilean Experience*

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Despite reform efforts, the economic performance of Latin American countries during the 199 disappointing with the exception of Chile, which grew at almost 7% per year. This paper tries explain this difference. Following recent literature that highlights the role played by institutio policies on economic growth, we estimate a cross-section econometric model over the 1960-2 period and find that Chile's better performance can largely be explained by a combination of institutions and reforms that have been deeper and broader in scope than those in the rest o America. In addition, we estimate that improving institutions in other Latin American countrie Chilean standard would have increased per-capita GDP growth rates by about one and a half percentage points.

Keywords: Economic Growth, Reforms, Institutions, Financial Development.

A pesar de las importantes reformas de la última década, el desempeño económico de Amér durante los años 90 fue pobre, a excepción de Chile, que creció a una tasa cercana al 7% an este trabajo intentamos explicar esta diferencia de desempeño entre Chile y el resto de la re Siguiendo la literatura reciente, que destaca el rol que tienen las instituciones y políticas sob crecimiento argumentamos que el mejor desempeño de Chile se debe a que el país llevó ade reformas más profundas y comprehensivas que otros países, en particular fortaleciendo su m institucional. Basados en un modelo econometrico de corte transversal estimado para el peri 1960- 2005, en este trabajo argumentamos que el mejor desempeño de Chile se explica principalmente porque el país cuenta con mejores instituciones y que América Latina podría incrementar el crecimiento de su ingreso per capita promedio en un 1,5% si tuviese institucio calidad similar a las chilenas.

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1. INTRODUCTION

Latin American countries grew steadily at about 5% per year in the three decades after Worl
But this process did not last long as it was interrupted by the debt crisis of the early 1980s, d
which most countries in the region went into recession (Table 1). The crisis brought to the su
structural problems, both macro and micro, existing at the time in most Latin American econ
Consequently, almost every country in the region spent the rest of the decade revising and a
their policies and implementing reforms aimed at changing the development model followed
then.

Following the debt crisis, the old import-substitution *cum* government intervention model beg
replaced by market-oriented economies, where resource allocation was to be driven mainly b
initiative and market forces. Thus, during the second part of the 1980s -the so-called *lost dec*
Latin American countries, one after another, began dismantling tariffs and other trade barrier
reducing fiscal deficits, fighting inflation, liberalizing prices and interest rates, lifting credit
restrictions, privatizing state owned enterprises, and reducing government intervention in the
economy. The aim was to achieve greater integration with the rest of the world, both in good
services and in financial flows. In the new development model the government was supposed
a complementary role and focus its attention only on the provision of public goods and the
institutional build up -*e.g.* public safety, legal system, regulatory and supervisory framework-
providing basic services to the poor -health care and education. Expectations were that by ad
the new model and implementing the policies recommended by the International Financial Ins
-the so wrongly called Washington Consensus (Williamson, 2003)- countries would start grow
again on a sustained basis. Social indicators would improve across the board and income ine
would be reduced.

After a decade of reforms, economic growth resumed, but the overall outcome fell short of
expectations: average growth during the 1990s, for the region as a whole, attained 3.3% an
since remained below the average of the three decades after WW II. Further, the region was
immune to crises (Mexico 1994-95, Ecuador 1999, Argentina 2001) and was also adversely a
by the 1997-98 financial turmoil. In addition, although there was an improvement in social in
like literacy or infant mortality, the drop in poverty was very marginal, and the per capita inc
with industrial countries broadened in most countries. These results have been the cause of
disillusionment with, and the so-called fatigue of, the reform process.

The exception to all of the above was Chile. The country not only grew steadily during thirtee
after the debt crisis at a much higher rate than in previous decades -annual growth during 19
averaged 7.3%-, but it was less affected by the turmoil of the late 1990s. And although grow
averaged only 2.6% during 1998-2003, it returned to 5.2% in 2004-2006. In addition, during
1990s the inflation rate fell to single digits, social indicators -except for income distribution- i
significantly (poverty fell by as much as 16 percentage points) and the per capita income gap
industrial countries was reduced by about 30%.

The contrasting experience of Chile *vis-á-vis* the rest of the region has not gone unnoticed. In
many researchers and policymakers have searched for explanations and, in the process, poin
to specific factors that distinguish Chile from the rest of the region. Potential candidates amo
factors include the depth and extent of the reform process -Chile started its reform in the mi
about a decade earlier than Mexico, the second country to begin reforms. The pension systen
of the early 1980s has also been singled out as an explanation as it provides a large savings
reduces the country's dependency on foreign savings to finance investment. And some have
that capital controls played a role -especially the so-called *encaje* (unremunerated reserve
requirement)- during the 1990s, when private capital returned to the region, because they re
the country's dependency on short-term and volatile flows, thus making it less prone to capit
and contagion effects.

Although all the factors above have most likely played a role, there is at least one complemen

explanation for the different economic performance of Chile and other Latin American countri is based on the most recent literature on economic growth that suggests that the ultimate ca country's growth lies on the quality of its institutions. Better institutions -property rights prot governance, lack of corruption and bureaucracy, rule of law, and the like- lead to the design policies and, therefore, allow countries to attain faster economic growth. Alternatively, for the set of policies, better institutions allow countries to reap off greater benefits in terms of grow the argument follows; Chile has been able to grow faster than other Latin American countries the late 1980s, although facing the same external environment and shocks, mainly thanks to better institutions.

This paper attempts to evaluate the statement above. That is, we try to find an explanation f different performance since the mid-1980s, with a focus on quantifying -to the extent possibl data availability- the contribution of different factors. We find that, as expected, both policies quality of the country's institutions influenced the outcome in terms of growth. In particular, that the better performance of Chile *vis-á-vis* Latin America during the 1990s, is explained by better policies and better institutions in almost equal shares -during the 1990s, per-capita GD Chile grew annually by about 3.2% more than in the rest of Latin America, about half of whic explained by better policies and half by better institutions. With regards to specific economic we find that keeping an overvalued real exchange rate, as some Latin American countries did consistently detrimental to growth. In addition, the reforms to the pension system in 1981 ar banking sector in 1986 were critical to foster the development of the financial sector and thus contributed to accelerate growth in Chile.

This paper is an attempt to put together the conclusions of two branches of the literature, on studies and draw policy lessons from the reform process in Latin America (IDB 1997, Lora 20 Fernandez-Arias and Montiel, 1997), and another that tries to explain economic growth using data sets, which lately has emphasized the role of institutions (Acemoglu *et at,* 2001; Rodrik 2002; Easterly and Levine, 2003). Using Chile as a counterfactual, we are able to quantify th benefits -in terms of increased economic growth- to be reaped-off by other Latin American co of adopting better policies and improving the quality of their institutions.

At least two policy conclusions emerge from our analysis. First, countries that are behind in t reform process compared to, say, Chile or Mexico that started earlier, can benefit and attain economic growth if they continue making progress in the so-called first generation reforms. S beyond economic reforms, countries would benefit by improving their institutions, which by n are much more persistent but, nevertheless, can be changed, as countries are not condemne with the institutions inherited from previous generations. This means that countries should n in their efforts to reform their institutional setup, even though the benefits materialize much than in the case of economic policies, because the payoff is quite large. Institutional buildup s a continuos effort, like it has been in Chile that for over three decades has been reforming its institutions and continues doing so.

The rest of the paper is organized as follows. Section 2 briefly describes the reform process i America in the past 25 years, highlighting the areas where most and least progress has been Section 3 summarizes the economic and social performance of Latin American economies sin War II. Based on previous work by others, section 4 evaluates the reforms implemented in th that is, it provides an overall assessment of what did and did not work. Section 5 looks into C reforms in greater detail. It advances an explanation of Chile's better performance by analyzi detail the existing differences in both policies and quality of institutions between Chile and th the region. Next, section 6 quantifies the relative contribution to economic growth of each se factors -policies and quality of institutions. In this section we examine the role played by spe reforms and policies in fostering growth, in particular the pension reform, the banking sector and the reduction of inflation. By explaining economic growth on a quantitative basis, this se provides an assessment of the potential benefits that a typical Latin American country would after improving the institutional set-up and advancing in the economic reform process. Finall 7 concludes and discusses the challenges ahead for most countries in the region.

2. ECONOMIC REFORM IN LATIN AMERICA: WHERE DO WE STAND?

The Latin American region, which grew steadily at about 5% per year during the 1950s, 196C 1970s, was severely hit by the debt crisis of the early 1980s. Prior to the crisis, almost every and especially the largest -Argentina, Brazil and Mexico-, had borrowed heavily in the interna capital markets. Thus, after running large current account deficits for a few years, these cour were severely affected when monetary policy shifted in the US and international interest rate raised causing a global slowdown (Table 1).

TABLE 1
CURRENT ACCOUNT BALANCE AND ECONOMIC PERFORMANCE
OF LATIN AMERICAN COUNTRIES DURING THE DEBT CRISIS

	Average Current Account Balance (% GDP) 1978-1981	Average GDP Growth (%) 1982-1983
Argentina	–2.4	0.3
Bolivia	–11.5	–4.0
Brazil	–4.5	–1.4
Chile	–8.6	–8.5
Colombia	–0.8	1.3
Costa Rica	–13.4	–2.2
Dominican Republic	–7.2	3.2
Ecuador	–7.1	–0.8
El Salvador	–3.6	–2.4
Guatemala	–4.0	–3.0
Honduras	–9.9	–1.1
Mexico	–4.7	–2.2
Paraguay	–8.8	–2.0
Peru	–1.1	–5.9
Uruguay	–4.7	–7.7
Venezuela	0.2	–2.4
Average	–5.8	–2.4

Sources: IMF, World Bank.

The crisis uncovered the major imbalances and structural problems that existed in most coun the region at the time, and set the stage for the reform process that occurred in the following The reforms were aimed first at attaining macroeconomic stability and reducing government Beyond that, the main goal was to replace the old import substitution cum government interv development model that had been in place for several decades. Instead, countries opted for developing outward oriented economies where market forces, as opposed to government acti would play a major role in allocating resources among competing sectors.

Starting with Mexico in the mid 1980s, one after another Latin American countries began implementing the same reforms that Chile had introduced in 1974-75 and thereafter. These i a program to reestablish macro stability, comprising a devaluation of the currency, a tighteni monetary policy and a fiscal adjustment with cuts in subsidies and non-essential programs. T was threefold: to reduce the fiscal deficit, to balance the external accounts and to fight inflati

In addition, countries began reducing both the level and the dispersion of trade tariffs while li other non-tariff barriers to trade and unifying multiple exchange rate systems. Trade integrat two forms; some countries opted for unilateral tariff reductions -like Chile had done in the 19 while others preferred trade agreements and the establishment of trade areas within the regi Mercosur, which in its first stage included only four countries, namely, Argentina, Brazil, Urug Paraguay. Also, countries implemented tax reforms whereby the VAT was introduced -Chile introduced the VAT in 1975- and some taxes were raised to compensate for the reductions in tariffs.

The reform process comprised three other areas, namely, financial liberalization, privatizatior owned enterprises (SOEs), and the labor market. Financial sector reforms included lifting rest on credit allocation, abolishing ceilings on interest rates, and reducing reserve requirements banks. The aim was to end the era of financial repression so that credit could be allocated to productive and profitable uses among competing economic sectors. In addition, state owned were privatized to improve their efficiency. Similarly, the privatization of SOEs sought to attra investment and attain higher levels of efficiency in the use of resources. Along the way, the privatization of banks and enterprises would provide extraordinary funds for the government would help to resolve debt problems. Finally, labor market reforms were aimed at increasing mobility and wage flexibility. Main objectives were to reduce the cost of firing by cutting seve payments and to abolish automatic salary adjustments to past inflation.

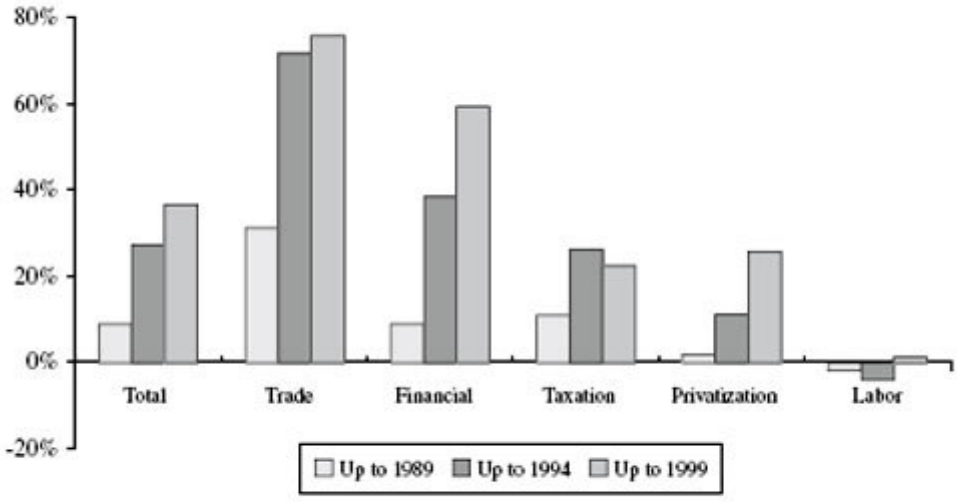
As mentioned, the goals of the reforms were to reestablish macro stability and to replace the development model that was based on import substitution and widespread government interv in the economy. The latter occurred through price controls, mandatory credit allocation, finan repression, subsidies to specific industries and exchange controls, among other measures, an the cause of governments running large fiscal deficits, high inflation rates and endemic balan payments deficits. In addition, labor legislation was overprotective and tended to reduce mob flexibility.

In the new market oriented development model the government relinquishes from the produc distribution of private goods that can be produced more efficiently by the private sector. Inste focuses on the provision of public goods -*e.g.* safety, judiciary system- and, most importantly implementing social programs to alleviate poverty and improve the access of the poor to basi services such as health care and education. But in the new model, education and health care do not have to be provided necessarily by the government; the poor, with financial support fr government, can buy these services from a private provider. In addition, in the new model th government does play a crucial role in market regulation and supervision. This comprises not financial sector and public utilities -which in many cases were privatized-, but markets in gen

The aim is to develop and maintain a competitive environment in all industries and sectors, a entails setting rates for natural monopolies such as utilities, strengthening the role of consum protection agencies, promoting market discipline and assuring free entry to all economic sect

Although the breadth and timing of the reform processes differ across countries, it is worth tr assess the degree of progress achieved throughout the region. As said, Chile made significant progress in several areas in the 1970s (few other countries did so in some areas), but the bu reforms in the region were implemented after the debt crisis. Figure 1 shows indicators of pro made in several areas as well as an indicator of general progress. All indicators are construct measure progress made since 1985. Although these indicators are subject to many caveats[1], indicative of the reform effort in the region as a whole. The figure shows that much progress in trade liberalization, especially up to the Tequila Crisis, and significant progress occurred in financial sector, although it was more evenly spanned through time[2]. Conversely, little progre been made in tax reform and in the privatization of state owned enterprises, and no progress the labor market. Thus, a lot remains to be done in Latin America in the last three areas.

FIGURE 1
PROGRESS IN THE REFORM PROCESS OF LATIN AMERICAN COUNTRIES

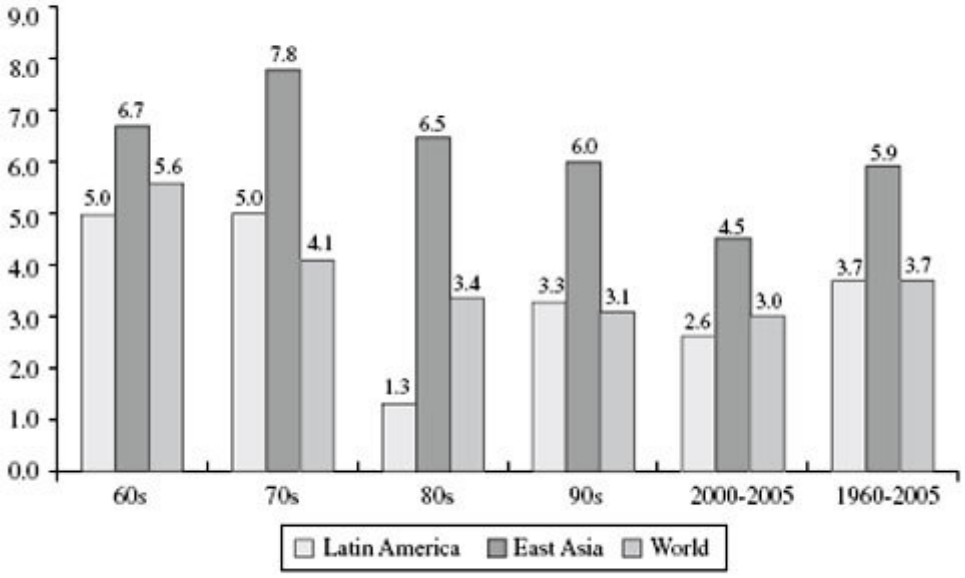


Note: Progress in reform is measured as the usage (in percent) in each date, of the total potential room for reform available in 1985. The potential available in 1985 is measured by the difference with the most liberalized country in the whole sample in each of the sub components. Source: Lora (2001).

3. LATIN AMERICA'S ECONOMIC AND SOCIAL PERFORMANCE

In the past 43 years, Latin America's economic performance has varied significantly from one to another, in contrast to the experience of East Asia. Further, on average Latin America grev about 60% the rate of East Asia for the whole 1960-2005 period, and has not yet recovered t of growth attained in the 1960s and 1970s, despite the recovery witnessed shortly into the re process (Figure 2).

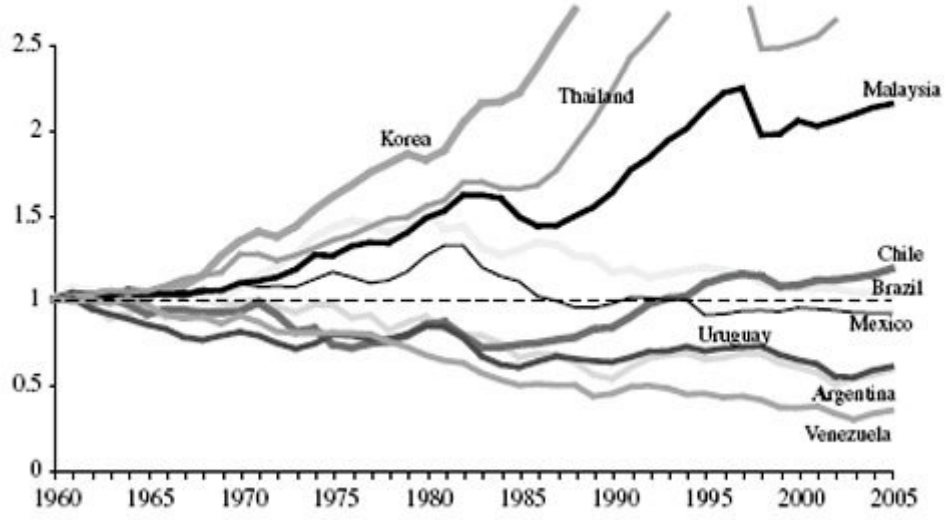
FIGURE 2
ECONOMIC GROWTH RATES (%)
(1960-2005)



Note: East Asia includes China, Hong-Kong, Indonesia, Korea, Malaysia, the Philippines and Thailand.
Source: World Bank, WDI (2007).

Among all Latin American countries, Chile is the only one that in the past eighteen years has average rates comparable to those attained by the East Asian economies. Chile's growth rate 2000 was very similar to that of South Korea, and between South Korea's and Indonesia's in 97. Costa Rica, the Latin American country that comes second after Chile in terms of growth, a much lower rate -about 2.5% less per year (Table 2). Consequently, among all Latin Ameri countries, Chile is the only one that, along with the emerging market economies from East As the past quarter century has closed its per-capita GDP gap with the industrial countries -Chile this gap in about 30% since 1980 (Figure 3).

FIGURE 3
RELATIVE PER-CAPITA GDP
Per capita GDP in each country as a fraction of US per capita GDP, normalized 1960 = 1



Source: Own elaboration.

TABLE 2
AVERAGE ECONOMIC GROWTH RATES
(Selected countries)

Country	1985-1997	1990-2000
China	10.1	9.6
Thailand	8.0	5.2
Korea	7.9	6.3
Malaysia	7.6	7.4
Chile	7.3	6.2
Vietnam	6.8	7.0
Indonesia	6.4	4.4
India	5.7	5.6
Uganda	5.7	6.8
Ireland	5.1	7.4
Israel	5.1	5.5
Costa Rica	4.7	5.1
Bangladesh	4.2	4.9
Colombia	4.2	2.9
Uruguay	4.0	2.9
Dominican Republic	3.8	4.9
Honduras	3.6	3.0
Panama	3.4	5.8
Paraguay	3.4	2.1
Guatemala	3.3	4.0
Japan	3.2	1.8
United States	3.2	3.2
Brazil	3.1	2.1
Bolivia	3.0	3.8
Ecuador	3.0	2.3
Philippines	2.9	2.9
Venezuela	2.9	2.5
Argentina	2.8	3.8
El Salvador	2.7	3.3
Peru	2.7	3.4
United Kingdom	2.7	2.3
Canada	2.6	2.7
Poland	2.6	2.7
Mexico	2.4	3.7
Germany	2.4	2.3
Italy	2.1	1.6
France	2.0	2.0
Jamaica	1.7	0.8
Trinidad and Tobago	-0.1	3.1
Nicaragua	-0.2	3.0
Haiti	-0.4	0.3

Source: IMF.

Chile's good performance also shows up in its social indicators. The most outstanding achieve the case of Chile has been poverty reduction; in the past 10 years the country has halved its rate -it went from 33% in the early 1990s, down to 17% in 2000 (Table 3). In contrast, pove reduction in the region at large has been modest -from 41 % to 36%- while in some countrie increased. It is worth noting that according to Attanassio and Székely (2001), about 85 perce poverty reduction in Chile can be attributed to high economic growth, while only 7 percent re from redistribution policies[3].

TABLE 3
POVERTY INDICATORS OF LATIN AMERICAN COUNTRIES

	Poverty[1]				Indigence[2]			
	Household		Population		Household		Population	
	Early 90s	Current[3]	Early 90s	Current[3]	Early 90s	Current[3]	Early 90s	Current[3]
Argentina	16	32	21	42	4	12	5	19
Bolivia	49	56	53	62	22	32	23	37
Brazil	41	30	48	38	18	10	23	13
Chile	33	17	39	21	11	5	13	6
Colombia	47	45	53	51	25	21	29	24
Costa Rica	24	19	26	20	10	8	10	8
Ecuador	56	43	62	49	23	16	26	19
Honduras	75	71	81	77	54	47	61	54
Mexico	39	32	48	39	14	9	19	13
Nicaragua	68	63	74	59	43	36	48	42
Paraguay	37	52	43	61	10	27	13	33
Uruguay	12	9	18	15	2	1	3	3
Venezuela	34	43	40	49	12	20	14	22
Latin America	41	36	48	44	18	15	23	19

Source: ECLAC (2004).
Notes:
[1] Poor is a household with per-capita income below the poverty line or minimum income to satisfy its essential necessities. The poverty line is calculated with the basic necessities cost method.
[2] Indigent is a household with per-capita income below the indigence line or minimum income to satisfy its essential nutritional necessities.
[3] Stands either for 2000, 2001 or 2002, depending on the country. In Chile it corresponds to 2000.

In sum, in the 1990s, economic growth resumed in the region but remained below the pre-de rates, widening the per-capita income gap with industrial countries. At the same time, povert reduction was modest, other social indicators improved and income distribution worsened. In contrast, Chile's growth rate during the decade was one of the highest around the world, bec the only Latin America country that converged in per-capita-income terms to the industrial cc

This brief revision of the economic and social performance of Latin American economies raise questions, in particular: Did the structural reforms implemented during the 1980s and 1990s any effect on countries' performance? What did Chile do differently that explains its better re The next two sections try to answer these questions by first summarizing previous findings a exploring in greater detail the reform process in Chile. Section IV provides an overall assessm why Latin American countries did not attain higher growth on a sustained basis, while Sectior advances an explanation of Chile's better performance by analyzing in detail the differences v rest of the region in both policies and quality of institutions.

4. THE REFORM PROCESS AND ITS RESULTS: AN ASSESSMENT

Early attempts at evaluating the reform processes in Latin America concluded that reforming countries reaped large benefits from them. The initial estimates concluded that the reforms implemented in the region up to the mid-nineties accelerated growth by about 2% per year (*et al.,* 1997; Fernandez-Arias and Montiel, 1997). But these results were subsequently contes new analyses that looked into longer time series. Nevertheless, more recent literature that re issue concludes that the reforms indeed contributed to accelerate growth, although the effect rather transitory, implying that to achieve a higher growth rate on a sustained basis countrie continue the reform process. Thus, for instance, according to Lora *et at* (2002) Latin America about 1.3% faster during 1991-93 because of the reform effort, but only about 0.6% faster i 99 both because the effects of previous reforms faded away and because the reform effort de

At least four other important conclusions emerge from the literature. First, results were unsa in some countries because of an insufficient reform effort; in other words, growth did not acc in those countries not because reforms failed, but because they were incomplete, either in sc depth (Fernandez-Arias and Montiel, 1997). Second, the pay-off from the reforms depends o

institutions. Thus, for instance, according to Lora *et at* (2002), reforms were more effective ir countries with good rule of law. Third, reforms are complementary; *i.e.,* the pay-off from, say trade reform -in terms of faster economic growth- was higher in countries with a more develc financial sector (Gallego and Loayza, 2002). And finally, reforms tended to affect growth mai through increases in total factor productivity, TFP, rather than through factor accumulation (L *at,* 2002).

The four results above are consistent with each other if one notes that the main source of grc recent decades has shifted from factor accumulation to TPF, that is, doing things better (not j doing more of the same by hiring more labor and capital). Beyer and Vergara (2002) decomp growth of a large (107) sample of countries during 1980-2000, and conclude that about 82 p the growth difference between the 10 percent -best and the 10%- worst performers can be e by changes in TFP, while only 18 percent is explained by faster factor accumulation[5].

In an era of rapid technological change, rapidly growing firms are constantly trying to improv procedures and attain greater efficiency by incorporating and adapting new technologies. For occur, a necessary condition is that prices reflect the actual cost of providing different goods services, which can be achieved by liberalizing prices and implementing several other market policies. In other words, what is needed is to reduce state intervention in the economy (excep externalities and other market failures that require the state to intervene). But this is not enc Also, the business environment must be such that the private sector has the incentives to inv the development and implementation of new and better technologies; that is, the business environment must be conducive to agents to get involved in constantly improving their efficie levels. For this, stable rules of the game and good institutions are needed. Among the latter a of law, property rights protection, absence of corruption, and low bureaucracy[6].

In sum, countries that do not put in place an adequate institutional setup, one that supports investment in innovation and the adaptation of new technologies, will not reap the benefits of attaining rapid economic growth even if other economic reforms take place, such as trade liberalization or macro stability. Indeed, Fernandez-Arias and Montiel (1997) suggest that this front where most Latin American countries failed during the reform process; not enough emp was put on building up and strengthening institutions. These authors acknowledge that some countries did not even complete the so called first generation reforms; *i.e.,* fiscal and macro s was not attained, as high inflation resumed after a short period, and trade liberalization was completed. In their view, completing the macroeconomic reforms that were partially impleme would have bridged a significant part of the growth gap observed during 1991-95 between Ea and Latin America. But, in their words, " ... *we suspect that it [the growth gap] is also associa other deep-seated institutional and structural differences in these economies as well. In any e the gap suggests the need for a broadening of the scope of reform in Latin America beyond th macroeconomic sphere if the region's economies are to achieve the standard of performance seek" .*

The next two sections of the paper address the issue raised by Fernandez-Arias and Montiel (particular, we try to explain Chile's better performance (described in section 3) on the countr institutions and continuos reform process. Section 5 below discusses in greater detail Chile's process, while section 6 provides some empirical evidence supporting the view that institution a difference. We also quantify the contribution of policies and institutions in Chile's growth, pa special attention to the factors underpinning the development of the financial sector.

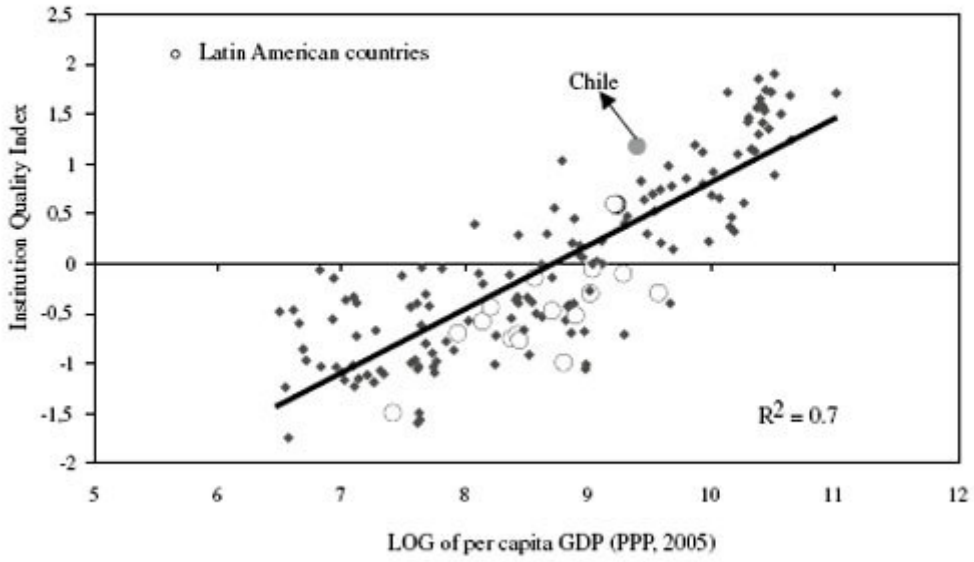
5. WHY IS CHILE DIFFERENT?

A common feature in the region is that countries are prone to suffer macroeconomic crises, w usually have fiscal roots and in some cases are even exacerbated by financial problems. Thes crises have delayed the reform process and in many instances resulted in major setbacks. In Chile muddled through the Tequila, Asian and Russian crises relatively unscathed, partly beca fiscal problems were faced early on, culminating with a stringent fiscal responsibility rule, and because it counts with a very robust banking sector.

With regards to structural reforms, toward the end of the 1990s most Latin American countrie advanced in trade openness, financial liberalization and, to a lesser extent, in tax reforms and privatization of SOEs (the so-called " first generation reforms"). The main difference in the implementation of these reforms was that Chile, followed by Colombia, Argentina and Mexico the reform process earlier (Morley *et al,* 1999). But even more important, Chile, unlike the re region, continued and deepened the reform process putting more emphasis in the institutiona buildup. A reform process without an adequate institutional setup that supports it, most likely have significant and sustained effects on economic growth, and can even result in adverse ou For instance, if financial liberalization is not accompanied by an appropriate regulatory and supervisory framework -one that protects creditors-, most likely the outcome will be a lendin followed by a financial crisis, like it occurred in Chile and other Latin American countries in th 1980s[7]. Similarly, a privatization program in a corrupt environment will most likely have nega effects on growth.

The most recent literature on economic growth has emphasized the role of policies and, most importantly, institutions, as the ultimate causes of factor accumulation and productivity gains is growing consensus in the literature that countries attain higher economic growth when the of law, property rights protection, low bureaucracy, low corruption, adequate supervisory and regulatory frameworks that guarantee a fair market competition, stable rules of the game, ar adequate checks and balances (Rodrik *et al.,* 2002; Easterly and Levine, 2003). All of these l either better economic policies or better outcomes for the same policies, and provide a busine environment that is more conducive to investment, innovation and the hiring of labor.

FIGURE 4
QUALITY OF INSTITUTIONS AND ECONOMIC DEVELOPMENT
(168 countries)



Sources: World Bank, and Kaufmann *et al.* (2003)

The role of institutions is clearly illustrated in Figure 4, which shows a scatter between per ca (as of 2005) and the quality of the countries' institutions for 168 countries. Two conclusions a highlighting: (i) Latin American countries tend to be in the bottom part of the figure (they ten have poor institutions and low GDP per capita); and (ii) Chile is the only Latin American coun appears significantly above the fitted line. In fact, according to Kaufmann *et al.* (2006), as of Chile appears as the best-ranked emerging market economy in terms of the quality of its inst (average of six categories), followed by Uruguay and then Costa Rica among Latin American countries. Chile is even ranked higher than some developed countries, namely Spain, Japan a (Table 4).

TABLE 4
INSTITUTIONAL QUALITY INDICATORS
(2005, Selected countries)

Ranking (out of 156 countries)	Country	Institutions Index	Voice and Accountability	Political Stability	Government Effectiveness	Regulatory Quality	Rule of Law	Control of Corruption
1	Finland	1.86	1.49	1.48	2.07	1.74	1.96	2.39
2	Denmark	1.74	1.51	0.91	2.12	1.69	1.99	2.23
3	New Zealand	1.72	1.39	1.20	1.90	1.66	1.95	2.24
4	Switzerland	1.72	1.43	1.26	2.03	1.47	2.02	2.12
6	Sweden	1.66	1.41	1.18	1.93	1.47	1.84	2.10
7	Netherlands	1.60	1.45	0.80	1.95	1.64	1.78	1.99
8	Canada	1.58	1.32	0.91	1.92	1.57	1.81	1.92
9	Australia	1.56	1.32	0.82	1.88	1.58	1.80	1.95
12	Singapore	1.47	-0.29	1.08	2.14	1.79	1.83	2.24
13	Germany	1.42	1.31	0.67	1.51	1.38	1.76	1.92
14	U.K.	1.42	1.30	0.34	1.70	1.53	1.69	1.94
17	United States	1.24	1.19	0.06	1.59	1.47	1.59	1.56
18	Chile	1.18	1.04	0.85	1.26	1.40	1.20	1.34
19	France	1.15	1.28	0.33	1.46	1.09	1.35	1.40
21	Japan	1.13	0.94	0.94	1.16	1.17	1.33	1.24
22	Portugal	1.12	1.32	0.94	1.03	1.20	1.10	1.13
23	Spain	1.10	1.12	0.38	1.40	1.25	1.13	1.34
28	Botswana	0.83	0.68	0.94	0.79	0.76	0.70	1.10
32	Korea, South	0.69	0.74	0.43	1.00	0.77	0.73	0.47
34	Italy	0.61	1.00	0.21	0.60	0.94	0.51	0.41
35	Uruguay	0.60	0.99	0.64	0.53	0.26	0.43	0.78
36	Costa Rica	0.60	0.99	0.76	0.30	0.61	0.54	0.38
41	Malaysia	0.41	-0.41	0.49	1.01	0.50	0.58	0.27
55	Thailand	0.03	0.07	-0.55	0.40	0.38	0.10	-0.24
63	Brazil	-0.08	0.36	-0.13	-0.09	0.08	-0.41	-0.28
64	Mexico	-0.10	0.29	-0.29	-0.01	0.33	-0.48	-0.41
66	Jamaica	-0.11	0.57	-0.33	-0.12	0.24	-0.55	-0.50
71	India	-0.2	0.35	-0.85	-0.11	-0.34	0.09	-0.31
72	Argentina	-0.29	0.43	-0.26	-0.27	-0.64	-0.56	-0.44
73	Dominican Republic	-0.29	0.20	0.05	-0.41	-0.27	-0.66	-0.66
78	Philippines	-0.38	0.01	-1.11	-0.07	-0.02	-0.52	-0.58
89	Peru	-0.47	0.04	-1.08	-0.60	0.10	-0.77	-0.49
93	Colombia	-0.51	-0.32	-1.79	-0.09	0.05	-0.71	-0.22
94	Lebanon	-0.53	-0.72	-1.14	-0.30	-0.28	-0.36	-0.39
95	Egypt	-0.55	-1.15	-0.90	-0.35	-0.47	0.02	-0.42
97	China	-0.57	-1.66	-0.18	-0.11	-0.28	-0.47	-0.69
98	Vietnam	-0.57	-1.60	0.34	-0.31	-0.64	-0.45	-0.76
106	Bolivia	-0.69	-0.09	-1.15	-0.80	-0.53	-0.78	-0.81
107	Guatemala	-0.71	-0.37	-0.89	-0.70	-0.26	-1.04	-0.98
108	Russia	-0.71	-0.85	-1.07	-0.45	-0.29	-0.84	-0.74
109	Indonesia	-0.71	-0.21	-1.42	-0.47	-0.45	-0.87	-0.86
111	Ecuador	-0.75	-0.16	-0.83	-1.01	-0.83	-0.84	-0.81
112	Paraguay	-0.76	-0.19	-0.62	-0.83	-0.77	-1.00	-1.19
116	Cameroon	-0.89	-1.19	-0.34	-0.90	-0.76	-1.02	-1.15
121	Venezuela	-0.99	-0.50	-1.22	-0.83	-1.15	-1.22	-1.00
122	Cuba	-0.99	-1.87	0.03	-0.94	-1.75	-1.14	-0.26
147	Haiti	-1.49	-1.41	-1.91	-1.39	-1.17	-1.62	-1.45
150	Sudan	-1.56	-1.84	-2.05	-1.30	-1.29	-1.48	-1.40
151	Zimbabwe	-1.59	-1.65	-1.58	-1.42	-2.20	-1.47	-1.24
153	Iraq	-1.77	-1.47	-2.82	-1.64	-1.61	-1.81	-1.27
154	Somalia	-2.18	-1.89	-2.51	-2.21	-2.35	-2.36	-1.74

Sources: Kaufmann, *et al.* (2006).

And the situation is very similar when looking at each of the index components: government effectiveness; regulatory quality; rule of law; control of corruption; voice and accountability; political stability. This difference between Chile and the other Latin American countries provid plausible explanation for Chile's better economic performance in the past decades.

Next we discuss the reform process in Chile since the early 1970s. The aim is to show that th reforms were deep and wide in scope in Chile. Also, that the reform process has not stopped; continues implementing policies in many areas. And third, that the institutional setup is not g can be modified (albeit slowly), so that countries with poor institutions are not condemned by legacy.

5.1 First Stage: The First Generation Reforms

When the economic reform process began, the Chilean economy was in complete disarray as intervened in virtually every area of production and interfered in many economic decisions. Furthermore, fiscal deficits were rampant and the economy was isolated from the rest of the

through a complex battery of trade restrictions. In a nutshell, by 1973 inflation was running a 500% per year, the fiscal deficit was about 30% of GDP, and the peso was artificially overval there were many capital and current-account restrictions aimed at containing the external im including a multiple exchange rate system. In addition, the average tariff was about 105%, tl effective protection varied across economic sectors due to a wide range of restrictions includi tariff barriers, and many prices were set (artificially low) by the government, creating a short goods and services in many markets. Further, the state owned about 600 enterprises, accour about 40% of GDP, and financial repression in the form of controlled (negative) real interest r restrictions on credit allocation was widespread.

The military government that took power in late 1973 inherited an economy in complete chac early years of the military government exchange rates were unified, prices were liberalized fc goods and services, and several enterprises, farms and banks that had been intervened and controlled by the state were returned to their previous owners. In addition, a major fiscal pac comprising drastic cuts in public investment and subsidies, and a freeze in public wages, brou fiscal deficit down to only 5% of GDP in 1974. The fiscal adjustment continued, bringing a 4% only two years later (in attaining this surplus it helped the economic recovery that followed th reforms).

But reforms went far beyond achieving stabilization and correcting mac-roeconomic imbalanc 1975, for example, the sales tax was replaced by the value-added tax (VAT) at a flat rate of 2 thus improving the efficiency of resource allocation[8]. Also, non-tariff trade barriers were liftec both the dispersion and the level of tariffs were unilaterally reduced for most goods. This proc continued into 1979, when a flat tariff of 10% was set for most goods[9].

Major reforms were also introduced in the financial sector, where interest rates were liberaliz banks privatized, mandatory credit allocation abolished, entry restrictions lifted, and the scop permitted activities broadened. But the end of financial repression was not preceded or accor by an upgrade -or even better, an overhaul- of the supervisory and regulatory framework, th exacerbating moral hazard and adverse-selection problems[10]. As a consequence, connected l between banks and enterprises grew unchecked, currency mismatches in bank borrower's ba sheets mounted up and non-performing loans were rolled over, while the system operated ur *facto* deposit insurance. This made the overall financial system prone to crisis and proved to l costly when the economy suffered severe shocks in the early 1980s.

The outcome of all the reforms above combined was a quick economic recovery and a sharp r in both the fiscal deficit and the inflation rate. Indeed, after a sharp recession in 1975[11], GDP average by about 6.8% per year during 1976-81 (7.5% in 1977-81). Similarly, inflation fell s reaching the two-digit level just a few years into the stabilization program, although it remair around 30% until 1980 (it was slightly below 10% only in 1981). The fiscal balance was in su through the entire 1976-81 period and the economy received large amounts of private capita mainly in the form of syndicated bank debt.

But major macro imbalances arose during this period. In particular, the real exchange rate appreciated significantly, the current account deficit climbed to 14.5% of GDP in 1981, and th financial sector weakened as major risks and vulnerabilities grew unchecked[12].

In this scenario of increasing macro-financial fragility, it is easy to understand why the econo plummeted when the external environment deteriorated in the early 1980s. The balance of pa crisis and the abandonment of the nominal peg that followed were unavoidable after private c inflows came to a halt in 1982. The ensuing real depreciation further aggravated the financial because of the large currency mismatches incurred by the private sector[13]. As a result, real G by about 16.4% (cumulative) during 1982-83.

The economic and financial crises caused a setback on some of the policies and achievements previous years. Indeed, the government had to take over several financial and non financial institutions, ending up controlling about half of the total bank credit[14]. Additionally it incurred

fiscal deficit and allowed higher inflation rates (in addition to higher tariffs[15]) to finance it.

It is important to single out two other reforms that were implemented just before the debt cr and which played a major role in the subsequent period: the new Constitution of 1980, and tl pension system reform of 1981.

The new Constitution of 1980 is important not only because it set the timetable for the returr democratic regime in Chile, but also because it granted the power to allocate government spe exclusively to the executive branch, thus closely linking expenditures with revenues[16]. Thus, the Chilean Congress can either pass or reject the coming year's budget law submitted to it b government, but cannot amend such law. This has proven to be an important factor for main fiscal discipline. In addition, the new Constitution prohibited the Central Bank from buying se issued by the government, thus precluding the monetization of the deficit. The Central Bank v given the explicit mandate to pursue the stability of prices (or of the currency), the stability c external payments, and the stability of the domestic payment system. Finally, it was granted independence from the executive branch by the way its authorities would be designated[17]. (I be mentioned that although legislated earlier, these changes came into effect *defacto* in 198 the country's return to democracy).

The pension system reform of 1981 consisted of the phasing out of the bankrupt pay-as-you- system and the creation of a fully funded capitalization system run by private, competing ent the new system workers make mandatory monthly contributions into personal savings accour which are managed by specialized private entities, and whose balances cannot be withdrawn retirement. This reform led to an increase in total savings and, at the same time, contributed development and deepening of the domestic capital markets, thus indirectly helping to raise t factor productivity -we explore this effect in greater detail below[18].

5.2 Second Stage: The Deepening and Institutionalization of Reforms

In the aftermath of the debt crisis, the government focused its policies on two areas: redoing the work of previous years -privatizing banks and enterprises taken over during the crisis, co reducing the budget deficit and inflation- and overhauling the institutional framework to corre problems and regulatory shortcomings that had been diagnosed during (and were partly resp for) the crisis[19]. Thus, a new tax law was enacted in 1984, which provided special incentives saving and investment. For instance, profits became non-taxable if reinvested (taxes accrued when profits were distributed in the form of dividends) and the corporate tax rate was reduce Also, new banking and bankruptcy laws were enacted in 1986. The new banking law granted powers to the supervisory and regulatory agencies, while updating specific regulations to kee with international standards and best practices. The new bankruptcy law set for very clear ste the liquidation and closure of banks and seniorities for the payment of debts to creditors.

Other important institutional changes included the setting of a framework for controlling and monitoring monopolistic practices, and the privatization of SOEs, comprising not only banks a firms taken over during the debt crisis, but also utilities formerly owned and operated by the such as electricity generation and distribution, long-distance and local telephone companies[21] new wave of privatization brought the share of SOEs in GDP down from 24% in 1983, to 13% 1989.

In 1989, a new Central Bank law was enacted, whereby the Central Bank's sole objectives ar stability of prices, the stability of the domestic payment system, and the stability of Chile's e payments. This new charter led the Central Bank, now autonomous, to adopt in 1991 a mone policy scheme based on inflation targeting and a widening exchange rate band. The exchange band was abolished later on (in 1999), leading to a free-float in which the Central Bank inter only when the exchange rate market becomes dysfunctional and the exchange rate is clearly misaligned from its fundamentals. As a result of all these changes, the inflation rate in Chile t converged to the Central Bank's steady-state target, a range of 2 to 4 percent per year, a lev nobody thought feasible just a decade earlier[22].

Also, new legislation allowing the participation of the private sector in infrastructure developn passed in 1991. According to it, roads, highways, airports, seaports and other infrastructure may be developed by the private sector under build, operate and transfer (BOT) arrangemen in 1994, a new law was passed permitting free entry to the -until then monopolistic- long-dis telecommunications market, the so-called " multi-carrier" system.

It is important to mention that during this period the country successfully transited from an authoritarian to a democratic regime. Despite all the uncertainties surrounding this transition change was smooth, in part because the new Administration confirmed most of the market e elements already in place, while concentrating on a social agenda. This way the economic ins created in previous years were validated and in many cases strengthened, so that uncertainty vanished. For instance, early on in 1990 the new democratic government deepened the open process by reducing the maximum import tariff from 15% to 11%. In fact, all four governme have been in power since 1990 have strengthened the market economy model, accelerated t opening up process, consolidated the fiscal position and improved regulations, while, at the s time, they have emphasized social policies and implemented new programs to alleviate pover

But the reform process has continued up to now with the introduction of policies and institutic changes aimed at further consolidating the market-oriented economic model and improving t Chilean economy's resilience to shocks. Thus, amendments to the banking law in 1997 allowe to undertake new businesses, including lending internationally, while upgrading some regulat *i.e.,* the Basel capital accord was adopted. In 1998 a law was passed unilaterally reducing the tariff by one percentage point every year, stopping at 6% in January 2003. Furthermore, in 2 Chile signed a free trade agreement with the European Union, in 2003 with the United States with South Korea, and in 2005 with China, thus consolidating the process of integration with economy. Also, in 2001 the government committed to achieving and maintaining a 1% *struct* fiscal surplus. Under this commitment, government expenditures are set every year to be 1 % less than the Government's *structural revenues,* which are defined as the revenues that woul in steady state[23]. This rule is intended to guarantee that the government will remain solvent long run. Also in 2001, all remaining capital controls were abolished, ending more than half a of a partly closed capital account. And during this period regulatory and tax changes were int aimed at increasing the efficiency and fostering the development of capital markets by provid incentives to save. Also, during this period the exchange rate band was abandoned, consolida both the inflation targeting and the free float regimes, while a voluntary unemployment insur scheme was introduced. Finally, in 2003 three new laws were passed that (i) established a cl career path for public servants, based on merits, thereby significantly reducing the scope for government to appoint political allies in senior positions; (ii) provided public funding for politi parties; and (iii) regulated private donations to political parties and candidates. These three l should increase transparency, reduce the scope for corruption, and allow the public sector to more qualified people.

In sum, Chile not only began its economic reform process a decade earlier than the rest of La America; it also completed and deepened many of the reforms in subsequent years. Further, changed the institutional setup to enhance the credibility -and effectiveness- of its policies an country's resilience to shocks. Without the continuos progress in all these areas, most likely t off in terms of growth would have been less than it was and the economy would have remain vulnerable to crises.

6. DEEPENING THE REFORMS: WHAT IS AT STAKE?

The previous section has shown how Chile introduced and deepened the reforms, putting spe emphasis on the institutional buildup. In the process, the country has established high credib its institutions have won reputation, being today of better quality than in all other countries i region.

Based on Chile's experience an interesting question arises: What benefits would accrue to co that intensify their reform process to attain Chile's -or higher- standards in terms of macroec indicators, policies and, most important, institutions?

6.1 Explaining Economic Growth and Volatility

Model Specification and Definition of Variables

To answer the question above we estimate a cross section of about 80 countries, whose empi
form is based on a theoretical model of conditional convergence as developed by Barro and S
Martin (1992). Besides following the standard procedure of the empirical growth literature, in
the long term growth rate of an economy depends on initial conditions and policy variables (t
known Barro-regressions), we also want to test the importance of institutions. Therefore we r
sets of regressions. In the first set the dependent variable is the average growth of per-capita
during 1960-2005. In the second, the dependent variable is the volatility (measured by the st
deviation) of the per-capita GDP growth rate over the same time period. The second set of
regressions is motivated by recent research by Acemoglu *et al.* (2003) that suggests that vol
not caused only by bad policies -exchange rate overvaluation, inflation, government consump
other- but also by poor quality institutions. Poor quality institutions may cause volatility direc
indirectly by leading to bad economic policies. The two regressions are of the following form:

$$(1) \qquad \dot{Y}_i = \alpha_0 + \alpha_1 \, \mathrm{QI}_i + \alpha_2 X_i + \varepsilon_i$$

$$(2) \qquad \sigma_{\dot{Y}_i} = \beta_0 + \beta_1 \, \mathrm{QI}_i + \beta_2 X_i + \mu_i$$

where Y is per capita GDP, QI is an index measuring the quality of institutions in each country
set of other explanatory variables, a dot over a variable means its change over time and ε an
random terms.

Following the standard literature, the set of explanatory variables X includes initial conditions
variables, and one endowment/geography variable. Among the initial conditions we include th
per-capita GDP in 1960, and the average years of schooling in 1960. Policy variables include
(measured as exports plus imports over GDP[24]), government consumption (in percentage of
the real exchange rate overvaluation, and financial development measured as the ratio of priv
credit to GDP. In the robustness exercises (Appendix, Table A.2) we also include the exchang
black-market premium, and the growth of the terms of trade. In equation (2) we also include
and its volatility, the volatility of government consumption and the volatility of term of trade
robustness check in Table A.3). All the policy variables are measured as the average for the 1
2005 period. For completeness, in the robustness exercises in Table A.2 we also include two
endowment/geography variables; either a dummy indicating whether the country has access
seacoast, or the proportion of land area within 100 km of the seacoast[25].

Our institution quality variable, QI, is obtained from the Governance Indicators dataset devel
Kaufmann *et al.* (2006), which is available biannually for the period 1996-2005 (annually for
05), the most complete dataset of this kind available[26]. For the estimation of equations (1) a
we take the average over 1996-2005 of the following six indices for each country[27]:

TABLE 5
INSTITUTIONAL QUALITY INDEX COMPOSITION

Index	Definition
Voice and accountability	Extent to which citizens can choose their government, political rights, civil liberties, and an independent press.
Political instability and violence	Likelihood that the government will be overthrown by unconstitutional or violent means.
Government effectiveness	Quality of public service delivery, competence of civil servants, and the degree of politicization of civil service.
Regulatory burden	Government control on goods markets, government interference in the banking system, excessive bureaucracy to start a new business, and excessive regulation of private businesses and international trade.
Rule of law	Protection of individuals and property against violence or theft, independent and effective judges, and contract enforcement.
Graft or control of corruption	Use of public power for private gain and degree of corruption.

Source: Kaufmann *et al.* (2006).

Econometric Problems

The estimation of equations (1) and (2) poses a problem, namely the potential endogeneity c of the right-hand-side variables; in particular, openness, financial development and the qualit institutions. To address this problem we use two-stage least squares and the standard instru suggested in the literature. The instrument for openness is the fitted value that results from a equation as suggested by Frankel and Romer (1999). For the quality of institutions we use a alternative instruments, namely the distance of the capital city from the Equator line, the etn linguistic fraction of the population, the fraction of the population speaking English, the fracti population speaking one of the major languages of Western Europe, and the origin of the lega system[28]. In the case of financial development, we take stock of the mounting evidence prov recent years proving that " financial development causes growth" and treat it as an exogenou variable. (Just for completeness we instrument this variable using the origin of the legal syste suggested by La Porta *et al.* (1999), but the results change only marginally.)

Before proceeding a methodological note is in order. The dependent variables in equations 1 are the average and the volatility of the per-capita GDP growth rate for 1960-2005, respectiv while in both regressions the variable indicating the quality of each country's institutions, QI, measured over 1996-2005. The difference in the QI variable between what we would like to r (the entire period 1960-2005) and what we can measure (it's only available for the period 19 2005), posses a measurement problem that could invalidate our results. Our results would st valid, however, if we assume that Chile had, on average, better institutions than the rest of L America over the entire 1960-2005 period, similar to the relationship that we observe in the 1996-2005. This assumption is consistent with an institutional path in which (i) the starting p the reform process across the LAC countries was similar until the mid seventies, when macro micro problems were common among Latin American economies, and (ii) a faster institutiona occured in the Chilean economy thereafter, which is plausible considering that Chile started t reform procces a decade earlier and advanced faster. Additionally, although it is debatable, t not a priori a reason to believe that Chile's institutions in the early 60s were worse than thos LAC countries[29].

Due to the problem above, to check for the robustness of our findings we re-estimate both cr sectional regressions for the shorter sample period, 1996-2005, although doing so leads to p results due to the greater importance of cyclical factors. The results show, as expected, that

the explanatory variables lose statistical significance, in particular financial development and overvaluation of the real exchange rate, while initial conditions appear less robust. However, quality of institutions variable turns out to be statistically significant, with the correct sign an even larger coefficient than in the regression with the long data set, which shows that our res robust to changing (reducing) the sample period[30]. This finding makes us believe that the res reported below are robust and that the coefficient a, can be interpreted as the minimum effe institutions on long run economic growth.

Results

The main results of estimating equations (1) and (2) are reported in Tables 6 and 7, respecti the regressions where we test for robustness are reported in Tables A.2 and A.3 in the Appen

TABLE 6
ECONOMIC GROWTH DETERMINANTES
Dependent variable: growth of per capita GDP at PPP prices

	(1) OLS	(2) OLS	(3) 2SLS	(4) 2SLS	(5) 2SLS	(6) 2SLS	(7) 2SLS
Institutions quality		0.0106* (4.48)	0.0095** (2.53)	0.0094** (2.50)	0.0089** (2.20)		0.0090** (2.18)
Others Controls:							
GDP per capita 1960	-0.0138* (-5.34)	-0.0177* (-7.23)	-0.0173* (-6.45)	-0.0175* (-6.48)	-0.0175* (-6.39)	-0.0143* (-4.87)	-0.0176* (-6.45)
Average schooling years 1960	0.0084* (4.02)	0.0067* (3.54)	0.0069* (3.53)	0.0069* (3.51)	0.0064* (2.73)	0.0071** (2.28)	0.0065* (2.66)
Openness	0.0056** (2.34)	0.0024 (1.04)	0.0027 (1.11)	0.0013 (0.47)	0.0025 (0.97)	0.0059** (1.97)	0.0015 (0.51)
Financial development	0.0101* (4.07)	0.0057** (2.33)	0.0062** (2.25)	0.0066** (2.38)	0.0081 (1.42)	0.0131*** (1.91)	0.0080 (1.33)
Government consumption	-0.0018 (-0.49)	-0.018 (-0.56)	-0.0018 (-0.57)	-0.0020 (-0.62)	-0.0019 (-0.58)	-0.0017 (-0.48)	-0.0020 (-0.62)
Exchange rate overvaluation	-0.0081*** (-1.74)	-0.0081** (-1.96)	-0.0080*** (-1.94)	-0.0078*** (-1.87)	-0.0075*** (-1.70)	-0.0067 (-1.32)	-0.0075*** (-1.69)
Instruments:							
Constructed trade share	No	No	No	Yes	No	Yes	Yes
Legal origin	No	No	Yes	Yes	Yes	Yes	Yes
Etnolinguistic fraction	No	No	Yes	Yes	Yes	No	Yes
F. P. S. E.(1)	No	No	Yes	Yes	Yes	No	Yes
F. P. S. W. E.(2)	No	No	Yes	Yes	Yes	No	Yes
Distance(3)	No	No	Yes	Yes	Yes	No	Yes
R-squared	0.59	0.68	0.68	0.68	0.68	0.58	0.68
Number of observations	77	75	75	75	75	76	75

Notes: *t* tests are in brackets. *, **, *** Significant at 1% , 5% and 10% respectively.
(1) Fraction of the population speaking English. (2) Fraction of the population speaking one of the major languages of Western Europe. (3) Distance from Equator of capital city.

TABLE 7
GROWTH VOLATILITY ESTIMATES
Dependent variable: Standard deviation of per capita GDP growth

	(1) OLS	(2) OLS	(3) 2SLS	(4) 2SLS	(5) 2SLS	(6) 2SLS	(7) 2SLS
Institutions		-0.0066*	-0.0080**	-0.0078**	-0.0148**		-0.0171**
		(-2.54)	(-2.32)	(-2.25)	(-2.25)		(-2.17)
Others Controls:							
Policy variables							
Financial development	-0.0112*	-0.0052***	-0.004	-0.0045	0.0065	-0.0124*	0.0097
	(-5.55)	(-1.71)	(-1.08)	(-1.22)	(0.72)	(-2.89)	(0.88)
Government consumption	0.0056	0.0056	0.0055	0.0052	0.0059	0.0052	0.0053
	(1.19)	(1.21)	(1.18)	(1.12)	(1.14)	(1.08)	(0.96)
Exchange rate overvaluation	0.0191*	0.0190*	0.0190*	0.0187*	0.0229*	0.0178*	0.0234*
	(3.61)	(3.67)	(3.67)	(3.59)	(3.52)	(2.85)	(3.31)
Openness	0.0022	0.0028	0.0031	0.0055	0.0028	0.0038	0.0104***
	(0.69)	(0.86)	(0.93)	(1.37)	(0.78)	(0.93)	(1.76)
Instruments:							
Constructed trade share	No	No	No	Yes	No	Yes	Yes
Legal origin	No	No	Yes	Yes	Yes	Yes	Yes
Etnolinguistic fraction	No	No	Yes	Yes	Yes	No	Yes
F. P. S. E.(1)	No	No	Yes	Yes	Yes	No	Yes
F. P. S. W. E.(2)	No	No	Yes	Yes	Yes	No	Yes
Distance(3)	No	No	Yes	Yes	Yes	No	Yes
R-squared	0.48	0.53	0.53	0.53	0.43	0.47	0.35
Number of observations	76	74	74	74	74	75	74

Notes: *t* tests are in brackets. *, **, *** Significant at 1%, 5% and 10% respectively.
(1) Fraction of the population speaking English. (2) Fraction of the population speaking one of the major languages of Western Europe. (3) Distance from Equator of capital city.

The first two regressions (columns) in Table 6 are simple OLS, before and after controlling for quality of institutions. The main conclusion that emerges from comparing the first two columns institutions matter, that is, not only the a, coefficient turns out to be significant, but excluding institutions variable biases upwards (in absolute value) all the other coefficients, except for in GDP. Note also that the results from columns 1 and 2 are consistent with previous findings: t convergence in per-capita GDP (poorer countries tend to grow faster), education and financia development affect growth positively, while keeping an overvalued exchange rate is detrimen growth. Openness and government consumption, although having the right sign, do not attai statistical significance at the standard levels[33].

As argued, some of the right-hand side variables may be endogenous and that may be causin in the results. Columns 3 through 7 address this problem by using instruments. In the regres column 3 we use instruments only for the institutions variable, in the one in column 4 we use instruments for institutions and openness but not for financial development, and in column 5 instruments for financial development and institutions, but not for openness. The regression i column 6 excludes the institutions variable and uses instruments for financial development an openness, and the regression in column 7 includes institutions and uses instruments for all th potentially endogenous variables.

The conclusions that emerge from columns 3 through 7 are very similar to those from columns 2, that is, institutions matter (excluding this variable biases all other coefficients), there is pe GDP convergence, the level of education matters, and among the policy variables the most in are exchange rate overvaluation and financial development. In addition, when using an instru financial development, the corresponding coefficient turns out larger but is estimated less pre (its marginal significance level is about 13% in columns 5 and 7).

Three other conclusions are worth noting from Table 6 (and confirmed by the robustness test

Table A.2). First, the coefficient that accompanies the institution variable, a,, is robust to mar alternative specifications and very stable (at around 0.0095). Second, the coefficients for the education and exchange rate overvaluation variables are not biased (or are only marginally s the institutions variable is excluded. And third, financial development matters for growth on i even after controlling for the quality of institutions.

Using the results from Tables 6 and A.2 (using the average coefficient ± one std. deviation), possible to estimate the potential effect for the average Latin American country of adopting C institutions, or even better, the institutions of developed countries or Finland's, the top one a the countries in the sample. The results, reported in Table 8, indicate that by having institutic quality similar to Chile's, the average Latin American country could raise its per-capita GDP g rate between 0.9% and 2.0% per year (or by about 1.5% per year, on average). Or better st having Finland's institutions the increase would be between 1.3% and 2.9% per year (or by a 2.1% per year, on average). Note that in this case Chile's per-capita GDP growth would raise about 0.6% per year on average, because the difference between Chile's and advanced econ institutions is marginal. Compared with historical growth rates of per capita GDP in Latin Ame (1.2% p.a. during 1960-2005, using a simple average, and 1.7% p.a. taking a GDP-weighted average), the potential raise is quite significant. It means that, on average, per capita GDP w double in about 20-25[34] years instead of 60 (these numbers change to 22-18[35] and 38, respe if using the GDP-weighted average).

TABLE 8
EFFECTS ON PER-CAPITA GDP GROWTH RATES OF HAVING INSTITUTIONS SIMILAR TO CHILE, THE MAJOR ADVANCED ECONOMIES, AND FINLAND

	Institutions like Chile			Institutions like major advanced economies			Institutions like Finland (Top one)		
	Min. (%)	Mean (%)	Max. (%)	Min. (%)	Mean (%)	Max. (%)	Min. (%)	Mean (%)	Max. (%)
Chile	0.0	0.0	0.0	0.0	0.0	0.1	0.4	0.6	0.9
Argentina	0.9	1.4	1.9	0.9	1.4	2.0	1.3	2.0	2.8
Bolivia	1.1	1.8	2.5	1.1	1.8	2.5	1.5	2.4	3.3
Brazil	0.7	1.2	1.7	0.8	1.2	1.7	1.1	1.8	2.5
Colombia	1.0	1.6	2.2	1.0	1.6	2.3	1.4	2.3	3.1
Costa Rica	0.3	0.6	0.8	0.4	0.6	0.8	0.7	1.2	1.7
Dominican Republic	0.9	1.4	1.9	0.9	1.4	2.0	1.3	2.0	2.8
Ecuador	1.1	1.8	2.5	1.2	1.9	2.6	1.5	2.5	3.4
El Salvador	0.8	1.3	1.7	0.8	1.3	1.8	1.2	1.9	2.6
Guatemala	1.1	1.8	2.5	1.1	1.8	2.5	1.5	2.4	3.4
Haiti	1.6	2.5	3.5	1.6	2.6	3.6	2.0	3.2	4.4
Honduras	1.0	1.7	2.3	1.1	1.7	2.4	1.4	2.3	3.2
Jamaica	0.8	1.2	1.7	0.8	1.3	1.8	1.2	1.9	2.6
Mexico	0.8	1.2	1.7	0.8	1.3	1.7	1.2	1.9	2.6
Nicaragua	0.9	1.5	2.1	1.0	1.6	2.2	1.3	2.2	3.0
Paraguay	1.1	1.8	2.6	1.2	1.9	2.6	1.5	2.5	3.4
Peru	1.0	1.6	2.2	1.0	1.6	2.2	1.4	2.2	3.0
Trinidad y Tobago	0.6	0.9	1.3	0.6	1.0	1.3	1.0	1.6	2.2
Uruguay	0.3	0.5	0.8	0.4	0.6	0.8	0.7	1.2	1.6
Venezuela	1.3	2.1	2.8	1.3	2.1	2.9	1.7	2.7	3.7
Simple average excluding Chile	0.9	1.5	2.0	0.9	1.5	2.1	1.3	2.1	2.9
Simple average including Chile	0.9	1.4	1.9	0.9	1.4	2.0	1.3	2.0	2.8
Weighted average excluding Chile	0.8	1.3	1.8	0.8	1.4	1.9	1.2	2.0	2.7
Weighted average including Chile	0.8	1.3	1.7	0.8	1.3	1.8	1.2	1.9	2.6

Notes: (1) Weighted averages are constructed using each country's GDP as weights. (2) Min and Max are calculated using the average coefficient plus/minus one standard deviation.
Source: Own elaboration.

The results above also provide an explanation for Latin America's poorer performance during 1990s *vis-á-vis* Chile or East Asia (this is reported in Table 8). In the former case, about half

predicted growth difference can be explained by better institutions and about half by better p (differences in initial conditions matter but less than differences in policies and institutions). A policy variables, financial development is by far the most important, suggesting that countrie pay special attention to promote the development of the financial sector. In the latter case, p played a much greater role, specially financial development, mainly because there is not muc difference in the quality of institutions between the average Latin American country and the a East Asian country. Although smaller in magnitude, the sustained overvaluation of the real ex rate also added to the poor performance of the average Latin American country.

With regards to GDP growth volatility, the results reported in Table 7 suggest that the quality institutions matter -better institutions reduce volatility- and, therefore, excluding this variable all the coefficients, especially the one on financial development (note that Tables 6 and 7 are in structure)[36]. In addition, using instruments (2SLS) changes the parameters of some variab appears to be less stable than α_1 as reported in Table 6). Most important, the only variable b institutions that matter is the overvaluation of the exchange rate (keeping an overvalued exc rate raises GDP growth volatility).

TABLE 9
DIFFERENCE IN GROWTH PERFORMANCE:
CHILE VS. LATIN AMERICA AND EAST ASIA VS. LATIN AMERICA
(1990-2000)

	Chile vs. Latin America (1990-2000)		East Asia* vs. Latin America (1990-2000)	
	Simple Average Countries	Weighted Average Countries	Simple Average Countries	Weighted Average Countries
Inicial GDP	-0.4%	0.3%	-0.3%	0.1%
Human Capital	0.3%	0.2%	0.2%	0.2%
Quality of Institutions	1.1%	1.1%	0.4%	0.3%
Financial Development	0.7%	0.7%	0.9%	1.0%
Exchange Rate Overvaluation	0.3%	0.2%	0.3%	0.1%
Predicted Difference	2.0%	2.5%	1.5%	1.7%
Actual Difference	3.3%	3.2%	2.1%	2.5%

* East Asia countries include Singapore, Indonesia, Korea, Malaysia, Philippines and Thailand.
Note: Weighted averages are constructed using each country's GDP as weights.
Source: Own elaboration.

Finally, Table 10 reports the (again, simulated) effect on the volatility of per-capita GPD grow the average Latin American country, of it adopting institutions of similar quality to Chile's, or better, Finland's. The reduction is significant: volatility would fall on average by about 40% p (from 4.2% to 2.5%) in the former case, and by about 57% (from 4.2% to 1.8%) in the latte (numbers are very similar if using simple or weighted average historical data).

TABLE 10
EFFECTS ON THE VOLATILITY OF PER-CAPITA GDP OF HAVING INSTITUTIONS SIMILAR TO CHILE, THE MAJOR ADVANCED ECONOMIES AND FINLAND

	Institutions like Chile			Institutions like major advanced economies			Institutions like Finland (Top one)		
	Min. (%)	Mean (%)	Max. (%)	Min. (%)	Mean (%)	Max. (%)	Min. (%)	Mean (%)	Max. (%)
Chile	0.0	0.0	0.0	0.0	0.0	-0.1	-0.4	-0.7	-1.1
Argentina	-0.9	-1.6	-2.3	-0.9	-1.7	-2.4	-1.3	-2.4	-3.4
Bolivia	-1.2	-2.1	-3.0	-1.2	-2.1	-3.0	-1.6	-2.8	-4.0
Brazil	-0.8	-1.4	-2.0	-0.8	-1.4	-2.1	-1.2	-2.1	-3.1
Colombia	-1.1	-1.9	-2.7	-1.1	-1.9	-2.7	-1.5	-2.6	-3.7
Costa Rica	-0.4	-0.6	-0.9	-0.4	-0.7	-1.0	-0.8	-1.4	-2.0
Dominican Republic	-0.9	-1.6	-2.3	-0.9	-1.7	-2.4	-1.3	-2.4	-3.4
Ecuador	-1.2	-2.1	-3.0	-1.2	-2.2	-3.1	-1.6	-2.9	-4.1
El Salvador	-0.8	-1.5	-2.1	-0.8	-1.5	-2.1	-1.2	-2.2	-3.2
Guatemala	-1.2	-2.1	-3.0	-1.2	-2.1	-3.0	-1.6	-2.8	-4.0
Haití	-1.7	-2.9	-4.2	-1.7	-3.0	-4.3	-2.1	-3.7	-5.3
Honduras	-1.1	-1.9	-2.8	-1.1	-2.0	-2.8	-1.5	-2.7	-3.8
Jamaica	-0.8	-1.4	-2.0	-0.8	-1.5	-2.1	-1.2	-2.2	-3.1
Mexico	-0.8	-1.4	-2.0	-0.8	-1.5	-2.1	-1.2	-2.1	-3.1
Nicaragua	-1.0	-1.8	-2.5	-1.0	-1.8	-2.6	-1.4	-2.5	-3.6
Paraguay	-1.2	-2.1	-3.1	-1.2	-2.2	-3.1	-1.6	-2.9	-4.1
Peru	-1.0	-1.8	-2.6	-1.0	-1.9	-2.7	-1.4	-2.6	-3.7
Trinidad y Tobago	-0.6	-1.1	-1.5	-0.6	-1.1	-1.6	-1.0	-1.8	-2.6
Uruguay	-0.4	-0.6	-0.9	-0.4	-0.7	-1.0	-0.8	-1.4	-2.0
Venezuela	-1.3	-2.4	-3.4	-1.4	-2.4	-3.5	-1.8	-3.1	-4.5
Simple average excluding Chile	-1.0	-1.7	-2.4	-1.0	-1.7	-2.5	-1.4	-2.4	-3.5
Simple average including Chile	-0.9	-1.6	-2.3	-0.9	-1.7	-2.4	-1.3	-2.4	-3.4
Weighted average excluding Chile	-0.9	-1.5	-2.2	-0.9	-1.6	-2.3	-1.3	-2.3	-3.3
Weighted average including Chile	-0.8	-1.5	-2.1	-0.8	-1.5	-2.2	-1.2	-2.2	-3.2

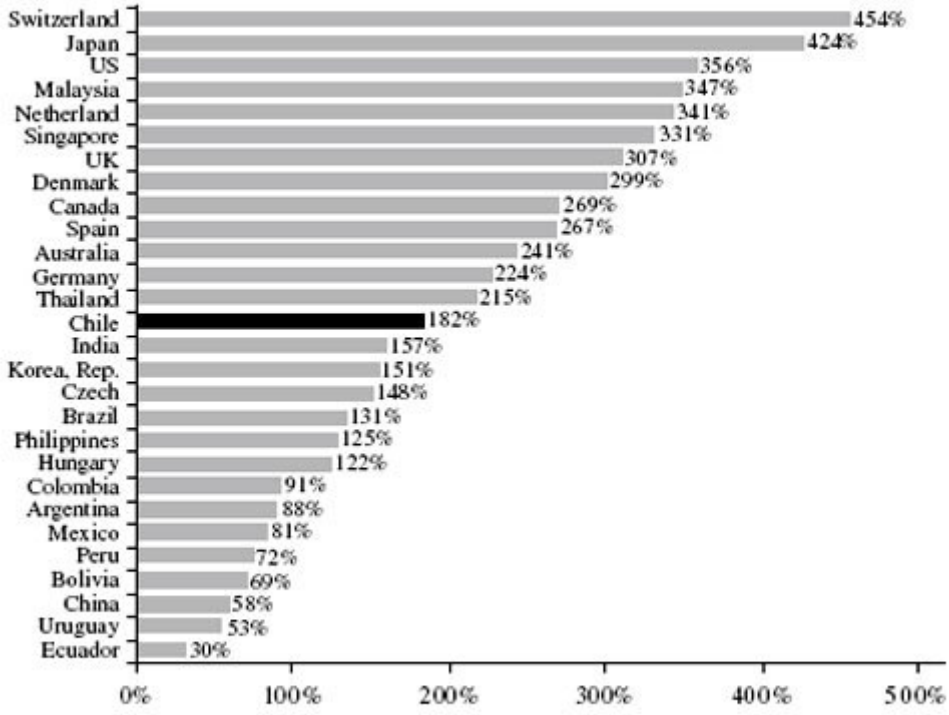
Notes: (1) Weighted averages are constructed using each country's GDP as weights. (2) Min and Max are calculated using the average coefficient plus/minus one standard deviation.
Source: Own elaboration.

6.2 Explaining Financial Development

The cross-sectional evidence from the previous subsection supports the view that both the qu institutions and the degree of financial development matter for growth. Further, when compa the other explanatory variables -initial conditions and the real exchange rate overvaluation- i out that these two variables explain most of the difference in economic growth performance b Chile and the rest of Latin America and between East Asia and Latin America during the 1990 9).

At this point it is therefore important to understand why the Chilean financial system is the la Latin America and one of the larger ones among emerging market economies (Figure 5). This subsection sheds some light on this issue and tries to identify the ultimate sources of the fina development in Chile during the past forty years.

FIGURE 5
FINANCIAL ASSETS
(2005, % GDP, selected countries)



Note: The assets of the financial system include liquid liabilities of banks and non-bank financial institutions, stock market capitalization, and domestic private and public bonds.
Source: Beck, Demirguc-Kunt and Levine (2006).

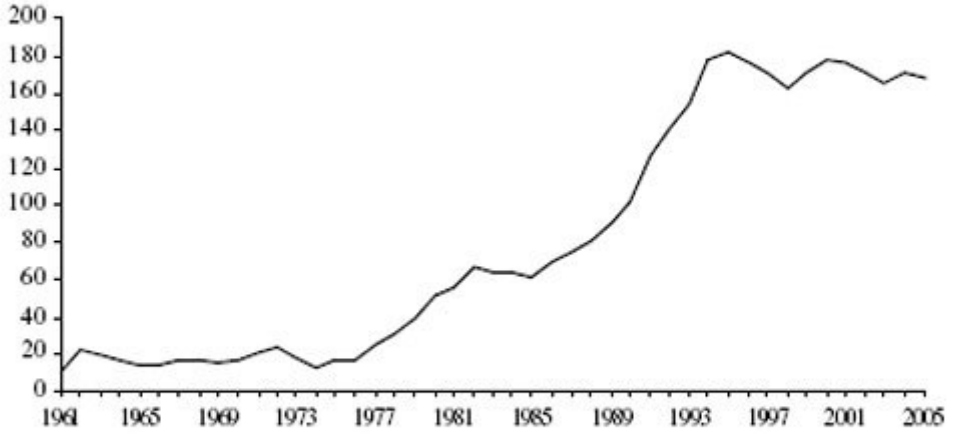
The literature that looks into the factors that explain financial development, which is mainly b cross-sectional studies, has identified two sets of explanatory variables, namely 'policy-relate determinants *(i.e.,* legal, regulatory and macroeconomic policies) and 'deeper' determinants (political, cultural, and even geographical factors). Regarding the first set of variables, La Port (1997,1998) show the importance of property rights protection in fostering financial developr Similarly, Beck *et al.* (2003a) conclude that the adaptability of the legal system is crucial, wh *et al.* (2003) show that adequate bank regulation and supervision -*i.e.,* providing incentives f greater information disclosure without granting regulators excessive powers- is important for development of the banking sector. With respect to macro policies, Boyd *et al.* (2000) and Kh (2002) find significant non-linear negative effects of inflation on the development of banks ar stock market. Similarly, Bencivenga and Smith (1992), Huybens and Smith (1999), and Roub Sala-i-Martin (1995) show how monetary and fiscal policies affect the taxation of financial intermediaries and, therefore, the provision of financial services.

With regards to deeper determinants, La Porta *et al.* (1998) emphasize the importance of the the legal system, while Stulz and Williamson (2003) highlight the role of religion. Finally, Bec (2003b), Easterly and Levine (2003), and Acemoglu *et al.* (2001) show the importance of geo in the shaping of institutions that, in turn, affect the development of the financial system.

In this subsection of the paper we follow the first approach and use time-series analysis to ex financial development in Chile. This approach has the advantage of allowing us to capture the contribution of key economic reforms undertaken in recent decades. For this purpose we use modified version of the empirical model developed by Corbo and Schmidt-Hebbel (2003), wh dependent variable measures the size of the Chilean financial market as a share of GDP. This measure, which adds up the most important financial instruments of the Chilean capital mark consistent with financial development measures frequently used in the literature. The constru variable consists of liquid liabilities of the financial system (banks and other non-bank financi

intermediaries), stock market capitalization, domestic private and public bonds, and mortgag bonds[37]. The evolution of this variable is showed in Figure 6.

FIGURE 6
FINANCIAL DEVELOPMENT IN CHILE
(1961-2005, percentage)



Note: Financial Development is defined as the sum of liquid liabilities of the financial system, stock market capitalization, domestic private and public bonds, and mortgage-related bonds, as a share of GDP.
Source: Own elaboration based on the procedure proposed in Bennett, Schmidt-Hebbel and Soto (1999).

The estimation seeks a co-integration relationship between the financial development variabl set of explanatory variables comprising the size of the (mandatory) pension industry, an inde measuring the progress in structural reform processes, and a few variables to capture other i macro-financial policies and reforms. Among the latter are two dummy variables to capture tl reduction in inflation and a variable that measures real exchange rate misalignment (the ratic including this variable is to control for cyclical fluctuations and for potential financial sector di due to balance sheet effects). In addition, we incorporate a variable that was not included in and Schmidt-Hebbel's model and that captures the 1986 reform to the banking sector.

The pension industry variable *(PR)* is equal to the annual mandatory savings flow of the new system created by the pension reform of 1981. The structural reform index *(SR)* is an averag progress achieved in trade openness, financial liberalization, tax reforms and privatization of owned enterprises. The inflation-related dummies identify thresholds; $D^{\pi<10}$ equals one when inflation is below 10%, while the second $(D^{\pi<20})$ equals one whenever inflation in the current adjacent years is below 20%[38,39]. Finally, the banking sector reform variable is a trend starti 1986 with diminishing returns over time (it takes the form t^{α}, where a takes the values of 1,(0.5). The estimation is done for the period 1961-2005. Our final specification adopts the follo form:

$$(3) \qquad FD_t = \gamma_0 + \gamma_1 PR_t + \gamma_2 SR_t + \gamma_3 D_t^{\pi<10} + \gamma_4 D_t^{\pi<20} + \gamma_5 RERG_t + \gamma_6 D_t^{BR86} + \varpi_t$$

where *FD* is the financial development, defined as the sum of liquid liabilities of the financial s (banks and non-bank financial intermediaries), stock market capitalization, domestic private public bonds, and mortgage-related bonds, each as a share of GDP, $D^{\pi<10}$and $D^{\pi<20}$ are the i related dummies, *RERG* is the real exchange rate misalignment -defined as the difference bet the real exchange rate and its long-term value computed using a Hodrick-Prescott filter-and *I*

the trend variable that captures the effect of the 1986 banking sector reform. Finally, 03_t is a term.

The results from estimating equation (3) are shown in Table 11. As expected, all variables ca significant at traditional confidence levels (except $D^{\pi<10}$ in two equations[40]) and with the exp signs. Further, all equations co-integrate at the 1 % significance level. Thus, we can conclude the explanatory variables *(i.e.,* the 1981 pension reform, the structural reforms, the 1986 ba reform and the reduction in inflation) had a significant effect on fostering the development of markets.

TABLE 11
FINANCIAL DEVELOPMENT ESTIMATES I
Dependent Variable: Financial development

	(1)	(2)	(3)
RERG	–0.383*	–0.380*	–0.366*
	(–3.13)	(–3.13)	(–2.98)
PR	8.485*	9.316*	10.152*
	(7.91)	(10.15)	(11.72)
SR	0.549*	0.541*	0.536*
	(5.52)	(5.45)	(5.29)
$D^{\pi<10}$	7.580***	6.290	6.235
	(1.74)	(1.41)	(1.36)
$D^{\pi<20}$	41.662*	40.485*	42.331*
	(6.31)	(5.98)	(6.32)
D^{BR86} (trend^0.5)	9.616*		
	(3.74)		
D^{BR86} (trend^0.75)		4.728*	
		(3.79)	
D^{BR86} (trend)			2.044*
			(3.54)
Adjusted R-squared	0.99	0.99	0.99
Co-integration test	Yes	Yes	Yes

Note: t tests are in brackets. *, *** Significant at 1% and 10% level respectively. Yes: Co-integrates at 1% significance level according to Mackinnon's critical values.

Using the estimated equations next we calculate the contribution of the different factors in ex the development of the Chilean financial markets. For this we divide the sample into two sub 1961-74 and 1986-2005. The first subperiod corresponds to the financial repression-cum-government-intervention development model, while the second corresponds to the market-or development model after the pension and banking reforms of 1981 and 1986, respectively. F development during the first subperiod averaged 17.4% of GDP, while during the second it a 145.8% of GDP. Of this increase -128.4 percentage points of GDP- about 37% is explained b pension reform of 1981; 25% by the reduction in inflation; 20% by the banking reform of 19 19% by other structural reforms (Table 12). Thus, it can be concluded that the pension refor contributed proportionately more than other reforms and policies to the development of the f sector in Chile.

TABLE 12
FINANCIAL DEVELOPMENT IN CHILE
1986-2005 vs 1961-1974

Explained by:	Absolute change in financial development index between 1986-2005 and 1961-74 (% GDP): 128.4		
	(1)	(2)	(3)
Pension Reform	33.3%	36.6%	39.9%
Other Structural Reforms	19.2%	18.9%	18.7%
Low Inflation Periods	25.8%	24.7%	25.7%
1986 Banking Sector Reform ($\alpha = 0.5$)	23.1%		
1986 Banking Sector Reform ($\alpha = 0.75$)		20.7%	
1986 Banking Sector Reform ($\alpha = 1$)			16.7%
Others	–0.4%	–0.9%	–1.0%

Source: Own elaboration.

Next, using the same approach we run similar regressions to identify those factors that expla development of the Chilean banking sector. For this we replace the dependent variable for tot credit (BC) to the private sector, also measured as a share of GDP (note that this definition m the one used in the cross-sectional analysis of subsection 6.1). Figure 7 shows the evolution variable.

FIGURE 7
BANK CREDIT TO THE PRIVATE SECTOR
Chile 1961-2005 (% GDP)

Source: Beck, Demirguc-Kunt and Levine (2006).

As can be seen in the figure, bank credit experienced a boom-bust episode in the late 1970s 1980s, which led to the 1981-83 debt-crisis[41]. One consequence of the crisis was that the government had to intervene and take over several financial institutions, leading to its contro about 60% of the domestic banking system. Furthermore, in the aftermath of the debt crisis government implemented several measures to clean up and re-capitalize the financial system this reason, a significant share of total credit in the years following the debt crisis consisted o emergency and soft loans granted under different criteria than the ones applied in normal tim privately run bank. To control for this effect we introduce a dummy variable ($D^{CR\ 8185}$) that e

during 1981-85 and zero otherwise.[42][43] This variable also replaces the previous one that con for cyclical effects, *RERG.* In addition, we change the functional form slightly by including infl directly instead of the dummy variables used before. Thus, our final specification takes the fo form:

$$(4) \qquad BC_t = \delta_0 + \delta_1 PR_t + \delta_2 SR_t + \delta_3 \left(\frac{\pi}{1+\pi}\right)_t + \delta_4 D_t^{BR86} + \delta_5 D^{CR81-85} + \xi_t$$

where π is the annual inflation rate, ζ_t is a random term and the other variables are as mentic above.

The results from estimating equation (4), reported in Table 13, are similar to those from equa More interestingly, the contributions of the different explanatory variables to the developmen banking sector differ from those presented earlier that referred to the financial markets. In pa bank lending to the private sector increased from an average of 8.6% of GDP during 1961-74 average of 60.4% during 1986-2005. Of this increase of 52 percentage points of GDP, about explained by the 1986 reform to the banking sector; 24% by other structural reforms; 22% b 1981 pension reform, and about 7% by the reduction in inflation[44] (Table 13). Thus, althoug reforms and stabilization policies matter, the banking reform of 1986 becomes more importa the pension reform, as expected.

TABLE 13
FINANCIAL DEVELOPMENT ESTIMATES II
Dependent Variable: Bank credit to the private sector as a share of GDP

	(1)	(2)	(3)
PR	1.191***	2.444*	3.128*
	(1.82)	(4.30)	(5.92)
SR	0.263*	0.285*	0.294*
	(3.83)	(4.19)	(4.40)
$\pi/(1+\pi)$	−14.636*	−15.526*	−15.874*
	(−3.30)	(−3.49)	(−3.57)
D^{BR86} (trend^0.5)	9.641*		
	(7.98)		
D^{BR86} (trend^0.75)		3.914*	
		(7.88)	
D^{BR86} (trend)			1.728*
			(8.00)
$D^{CR81-85}$	30.967*	26.881*	24.790*
	(9.96)	(9.53)	(9.36)
Adjusted R-squared	0.97	0.97	0.97
Co-integration test	Yes	Yes	Yes

Note: *t* tests are in brackets. *, *** Significant at 1% and 10% level respectively. Yes: Co-integrates at 1% significance level according to Mackinnon's critical values.

7. FINAL REMARKS: THE CHALLENGES AHEAD FOR LATIN AMERICA

This paper addresses the issue of explaining the contrasting experience of Chile, that during t 1990s grew at high rates and reduced its poverty rate sharply, with that of the rest of the La American region, that although recovering from the very poor performance of the 1980s (the

called lost decade), failed to resume the growth rates of the 1960s and 1970s.

Based on recent theoretical and empirical findings, we argue that Chile's success story is due breadth of its reform process, that continues to this date and has been much deeper and broa scope than that carried out in other countries. The reform has not only boosted the country's fundamentals but also upgraded and strengthened its institutions. The high payoff from Chile is due to its breadth and continuance through time.

Our econometric exercises show the importance of institutions in explaining long run econom growth, and this result is very robust to different econometric specifications. Indeed, we argu the better performance of Chile vis-á-vis Latin America during the 1990s is explained by both policies and better institutions in almost equal shares. In addition, we estimate that by havin institutions of quality similar to Chile's, the average Latin American country could raise its per GDP growth rate by about 1.5%, on average. Time series estimations showed that Chile's 198 pension reform and 1986 banking sector reform and macro stability (reduction in inflation) w critical to foster the development of the financial sector and thus accelerate economic growth

One conclusion that emerges from looking at the Chilean experience is straightforward: count should advance in all fronts, in many cases completing the so-called first generation reforms: fiscal stability, trade liberalization, inflation reduction. But there is also the need to advance in generation reforms: upgrading the supervisory and regulatory framework of banks, and refor pension systems. The latter in the case of Chile has proven to be key to the attainment of dee financial markets and higher economic growth.

The need to advance in all these fronts becomes even more urgent given the impending globa trend. In other words, given the increasing (and unavoidable) integration of the world econor both goods and capital flows, countries that do not reform their economies and institutions no will not reap all the benefits from this trend, but will also become increasingly prone to crises should also be mentioned that the longer countries try to delay -most likely unsuccessfully- th integration into the world economy, the larger the income gap with the industrial world will be latter because in a world of very rapid and frequent technological changes, opportunities arise exploited quickly by the most dynamic and open economy. In sum, the globalization trend pr opportunities, but the potential benefits will not materialize if countries do not upgrade their institutions and policies.

The above is more easily said than done. This, because there are no short cuts and the exper one country cannot be easily replicated by another; what works in one case does not necessa in another. So, to make progress countries should be innovative in the design of their policies institutions. Each country has to design its own policies and implement them taking into acco own characteristics: the way China has proceeded in the past two decades is certainly not a r the reforms implemented elsewhere. Similarly, Chile's 1981 pension reform which, as said, w foster the development of the country's financial sector, was not copied from elsewhere; it wa new and started from scratch. Further, countries that have tried to copy the Chilean system, however, have not always succeeded because of their own idiosyncrasies. Another example is unremunerated reserve requirement or *encaje* that Chile used in the 1990s that, albeit some controversy about its effectiveness in achieving all the objectives for which it was designed, c the composition of capital inflows toward those more stable and with longer maturities, reduc country's exposure to capital flight. This policy tool worked in Chile because of the rule of law tight monitoring exerted by the Central Bank on commercial banks, but by its nature is a pote source for corruption.

A second conclusion of the paper, supported by our econometric exercises, refers to the impo other institutions -rule of law, control of corruption, government effectiveness, political stabili are beyond the realm of political economy but, nevertheless, affect growth significantly. Altho there is no straightforward conclusion in this respect, we share the view that these institution given and countries are not condemned to their legacy, and the Chilean experience confirms instance, in Chile after 30 years of reforms the general public has begun to acknowledge the importance of building a strong institutional setup to provide and support a market friendly

environment with stable rules of the game that attracts investors, foreign or domestic. The la allowed the government recently to pass legislation to establish a merit-based career for pub servants, which reduces the chances of appointing political allies. Similarly, after about 25 ye the pension reform, workers (in the formal market) have become increasingly aware that the pension depends on their own contributions to their retirement funds and not on government policies. Therefore, they are much more demanding than in the past with regards to transpar disclosure, regulatory issues and other aspects pertaining to the pension fund industry.

Finally, one final challenge of Latin American countries, including Chile, is the urgent need to real progress in social policies, especially those aimed at protecting the poorest and unskilled This, because the current speed of technological change increasingly demands skilled workers are more capable to adjust to the new technologies. Thus, making progress in the macro, mic institutional fronts to accelerate growth and reap the benefits from the ongoing globalization not enough; this must be accompanied by adequate social policies -better opportunities to ac human capital- to assure that the poor are not left behind. Not making progress in improving distribution could undermine public support for the reform process, jeopardizing its continuan through time and risking social unrest and major setbacks or worse, reversals.

NOTES

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[1]The indices measure, for each area, how liberalized is each country compared to the least lib country in the whole sample. The sample period is 1985-99 in Lora (2001) and 1970-95 in Mo *al.* (1999). For more details see Lora, 2001; Lora and Barrera 1997; and Morley *etal,* 1999.

[2]According to Morley *et al.,* significant progress also occurred up to 1995 in the opening of th account.

[3]The results from Attanassio and Székely (2001) refer to the drop in poverty between 1987 a According to these authors, about 8% of the drop in poverty is a residual and cannot be expla their model.

[4]Although it is not the topic of this paper, it is important to comment that one area in which C not been successful is in altering its income distribution. Thus, not only income distribution deteriorated in Latin America in the past 30 years, becoming one of the worst in the world, bu Gini coefficient above 0.55 Chile's income distribution is one of the worst in the region. The li between growth and income distribution is not as clear as the link between growth and pover improving income distribution it is necessary to implement social policies focalized in the poor group, and economic growth contributes to finance such policies.

[5]It is possible to provide a different interpretation of this result. In particular, given the way t computed the contribution to growth of *Ah,* AK and ATFP, the latter element captures not only efficiency gains but also other unidentified shocks (" bad or good luck"). Therefore, it could b argued that the best performers, those countries showing a higher contribution of ATFP, are t more resilient to shocks (where negative shocks were less harmful). This resilience may, in tu direct result of better institutions and policies.

[6]Note that this explanation does not preclude the possibility that a better business environme

besides being more conducive to research and investment in innovation, lead to faster factor accumulation.

[7]On this topic see De Gregorio and Guidotti (1995).

[8]Over time, the VAT became the most important source of government revenue, amounting t 50% of total taxes.

[9]Only a few exceptions remained, like cars and luxury items such as fur and jewelry.

[10]See Barandiarán and Hernández (1999).

[11]The recession resulted from the fiscal stabilization program, the first oil shock, and the fall price of copper in the world market.

[12]The risks included unmatched currency liabilities incurred by banks' debtors, weak asset ra systems, under-provisioning, connected lending, and rolling over of bad loans (evergreening balance sheets).

[13]The fiscal cost of the financial crisis is estimated to be close to 40% of GDP. For more detai Chilean banking crisis of the 1980s, see Barandiarán and Hernández (1999).

[14]The intervened institutions were later on privatized, merged or shut down.

[15]Import tariffs were temporarily raised to help the fiscal adjustment.

[16]Prior to this legal change, the legislative branch shared the power to allocate public money, not required to provide the necessary funding, thus exacerbating the bias toward having a la deficit purely for political reasons.

[17]Pursuant to the law, the Central Bank is run by a Board composed of five members, each o appointed for a ten year term; every two years a new member is appointed. Board members nominated by the government, but need senate approval. The Governor is then chosen amon five board members by the country's President for a period of five years, or the time remainir member's term, whatever is shorter. The Deputy Governor is chosen by vote among the othe members of the Central Bank Board.

[18]See Corbo and Schmidt-Hebbel (2003).

[19]It should be stressed that the decision to maintain the outward oriented market-economy n the aftermath of the debt crisis was crucial to determine the country's economic performance subsequent years. Indeed, after that almost a decade of economic reforms had ended in a re and deep financial crisis, the development model was discredited. In this setting it could have easily replaced by the inward looking model with greater government intervention, thus reve progress achieved during the past decade. Fortunately, the authorities at the time decided to maintain the same overall development strategy, focussing instead on correcting its institutio regulatory shortcomings.

[20]At the same time, double taxation on dividends was abolished by giving shareholders a tax to be used in their personal income tax, equal to the proportional corporate tax paid by the c

[21]For details see Larrain and Vergara (2001).

[22]Thus, an inflation that started to develop in 1860 was finally controlled by the late 1990s.

[23]In other words, expenditures are one percentage point of GDP less than the revenues that occur if the economy were on its long-term path (after eliminating cyclical variations in taxes other key variables such as the price of copper and the level of international interest rates).

[24]For robustness checking, in a few regressions we use the alternative suggested by Calderón and Serven (2003), but the results do not change. This alternative variable is labeled openne the Appendix, Table A.2 and A.3.

[25]The precise definition and source for each variable is provided in table A.1 in the appendix.

[26]For a complete description of the methodology used for constructing these institutional indi see Kaufmann *et al.* (2006).

[27]Other papers use Rule of Law as an indicator of the quality of institutions. Although we use broader index, the results reported below are robust to the use of Rule of Law. Besides, the correlation between our broader index and the latter is 0.97.

[28]Another instrument proposed by Acemoglu *et al.* (2002) is the mortality rate of settlers. We use it because doing so would reduce our sample size significantly.

[29]Although there is not empirical evidence in this regard, compared with other LAC countries always been perceived as a country with low corruption and good rule of law.

[30]Results are available upon request.

[31]Table A.2 shows robustness exercises for the economic growth equation. In this table, colu through 13 include other controls such as terms of trade growth, black market premium, and endowment/geographic variables (a dummy indicating whether the country has access to the seacoast, and the proportion of land area within 100 km of the seacoast). In columns 14 thro 16 we use instruments for openness and financial development (and try different control vari In columns 17 and 18 we use a different definition for openness. Finally, in columns 19 throu try different combinations of instruments. Table A.3 shows robustness exercises for the grow volatility equation. In this table, in columns 8 through 11 we prove different controls such as and its volatility, and government consumption volatility, while equation 12 includes only sig variables. In columns 13 through to 16 we use also instruments for openness and financial development (and try different control variables). In columns 17 and 18 we use a different de for openness. Finally, in columns 19 through 20 we try different combinations of instruments previous version of this paper we present more robust test equations and results do not chan Hernández y Parro, 2005).

[32]It should be mentioned that, as we follow the standard literature, our results are subject to same caveats and shortcomings of all recent papers on institutions and growth, in particular respect to the choice and validity of the instruments and the estimation procedure (Acemoglu 2001, 2003; Beck *et al.,* 2003a, 2003b; La Porta *et al.,* 1997, 1998, 1999). For a test on the of the instruments see Easterly and Levine (2003) and Rodrik *et al.* (2002).

[33]Empirical results indicate that the effect of openness on GDP growth is ambiguous. In partic cross-section studies tend to find no such effect or the effect, when shown, is not robust, whi positive and robust effect emerges in panel data studies that capture the temporal effect of o See Calderón *et al.* (2004) for a complete review of the empirical literature about the effect o openness on economic growth.

[34]20 if compared to Finland's institutions and 25 if compared to Chile's

[35]18 if compared to Finland's institutions and 22 if compared to Chile's.

[36]That is, regressions in columns 1 and 2 are OLS estimations with and without the institutior variable; regressions in columns 3 through 5 use instruments for some of the potentially end variables (in the same order explained in the text); and columns 6 and 7 use instruments for endogenous variables, openness, financial development and quality of institutions (column 7)

[37]Following Beck *et al.* (2000), beginning- and end-of the year financial variables were CPI-d and then averaged. This average was then divided by GDP (deflated by the year-average CPI

[38]Corbo and Schmidt-Hebbel try different functional forms and thresholds for inflation. The du defined as explained in the text are their preferred specification.

[39]This functional form explicitly acknowledges the presence of non-linear effects of inflation o financial development and hence growth.

[40]This result and the statistical significance of the $D^{n<2°}$ dummy are consistent with the exist non-linear effects of inflation on financial development (see footnote 39).

[41]See De Gregorio and Guidotti (1995).

[42]Changing the crisis years changes the estimated coefficients but not the qualitative results, although it makes the co-integration relationships less stable.

[43]Ideally we would like to run the regression excluding the debt-crisis years, that is, for the p years. But this would imply that we couldn't properly control for the pension system and banl sector reforms of 1981 and 1986, respectively -in particular, the effects of the latter would m appear in the constant of the estimated model.

[44]Note that in this new functional still has non-linear effect on the development of the bankin

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APPENDIX

APPENDIX

TABLE A.1
VARIABLE DEFINITIONS AND SOURCES

Variable	Description	Source
Growth rate of GDP per capita	Annual GDP growth rate minus population growth rate, 1960–2005	World Bank, World Development Indicators 2007 and Penn
Standard deviation of growth	Standard deviation of GDP per capita growth rate, 1960–2005	Own elaboration
GDP per capita 1960	Logarithm of GDP per capita, on Purchasing Power Parity Basis, in 1960	World Bank, World Development Indicators 2007
Average schooling years 1960	Logarithm of average years of schooling in 1960	Barro and Lee (2000)
Openness1	Logarithm of sum of exports and import of goods and services as percentage of GDP, 1960–2005	World Bank, World Development Indicators 2007
Openness2	Residual of regression of volume of trade over GDP on country size and dummy for oil exports, 1960–2005	Own elaboration
Financial development	Logarithm of credit to private sector over GDP, 1960–2005	Beck, Demirguc-Kunt y Levine (2006)
Government consumption	Logarithm of government consumption over GDP, 1960–2005	World Bank, World Development Indicators 2007 and Penn
Government Consumption Vol.	Standard deviation of government consumption, 1960–2005	Own elaboration
Exchange rate overvaluation	Logarithm of real exchange rate overvaluation index, 1960–2005	Easterly and Levine (2002) using the methology of Dollar (
Exchange rate overvaluation Vol	Standard deviation of exchange rate overvaluation index, 1960–2005	Own elaboration
Black market premium	Black market premium on foreign exchange, 1960–2005	Easterly and Levine (2002)
Term of trade growth	Annual growth of terms of trade, 1960–2005	World Bank, World Development Indicators 2007
Term of trade volatility	Standard deviation of terms of trade, 1960–2005	Own elaboration
Inflation	Logarithm of annual inflation, 1960–2005	World Bank, World Development Indicators 2007
Inflation Volatility	Standard deviation of inflation rate, 1960–2005	Own elaboration
Landlock	Dummy variable taking value 1 for countries without access to the sea, 0 otherwise	Gallup and Sachs (1998)
Land100	Proportion of land area within 100 km of the seacoast	Gallup, Sachs and Mellinger (1999)
Constructed trade share (Frankel and Romer)	Logarithm of predicted trade shares computed from a bilateral trade equation with "pure geography" variables	Frankel and Romer (1999)
Legal origin	Dummy variable for legal origin of laws: German, French, Scandinavian, Socialist or English	La Porta, Lopez de Silanes, Schleifer and Vishny (1999)
Ethnolinguistic fraction	Ethnolinguistic fraction of the population	La Porta, Lopez de Silanes, Schleifer and Vishny (1999)
Fraction of the population speaking English	Fraction of the population speaking English	Hall and Jones (1999)
Fraction of the population speaking one of major languages of Western Europe	Fraction of the population speaking one of major languages of Western Europe	Hall and Jones (1999)
Distance from Equator of capital city	Distance from Equator of capital city	La Porta, Lopez de Silanes, Schleifer and Vishny (1999)

TABLE A.2
ROBUSTNESS CHECK FOR ECONOMIC GROWTH EQUATIONS
Dependent Variable: GDP per capita Growth (PPP)

	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)
Institutions	0.0098**	0.0097**	0.0104**	0.0089**	0.0089***	0.0091**	0.0089***	0.0095**	0.0088**	0.0093*	0.0095**	0.0113*
	(2.37)	(2.35)	(2.38)	(2.24)	(1.87)	(2.26)	(1.93)	(1.97)	(2.13)	(2.18)	(2.10)	(2.10)
Others Controls:												
GDP per capita 1960	-0.0174*	-0.0172*	-0.0178*	-0.0172*	-0.0171*	-0.0173*	-0.0175*	-0.0177*	-0.0170*	-0.0170*	-0.0177*	-0.0183
	(-6.15)	(-6.04)	(-5.84)	(-6.55)	(-5.80)	(-6.13)	(6.08)	(-6.10)	(-5.79)	(-5.56)	(-6.48)	(-5.80)
Average schooling years 1960	0.0070*	0.0068*	0.0069*	0.0068*	0.0072*	0.0068*	0.0065*	0.0066**	0.0061*	0.0061**	0.0066*	0.0058*
	(3.59)	(3.21)	(3.21)	(3.55)	(3.03)	(3.04)	(2.64)	(2.47)	(2.66)	(2.54)	(2.64)	(2.17)
Openness1	0.0028	0.0024	0.0023		0.0027		0.0016	0.0002			0.0014	0.0002
	(1.15)	(0.86)	(0.79)		(0.97)		(0.53)	(0.04)			(0.46)	(0.05)
Openness2									-0.0019	-0.0011		
									(-0.67)	(-0.22)		
Financial development	0.0061**	0.0061**	0.0059**	0.0071**	0.0063**	0.0067**	0.0084	0.0074	0.0079	0.0073	0.0072	0.0081
	(2.18)	(2.16)	(2.01)	(2.42)	(2.01)	(2.23)	(1.33)	(1.11)	(1.37)	(1.13)	(1.07)	(1.34)
Government consumption			-0.0020								-0.0020	-0.0021
			(-0.54)								(-0.61)	(0.63)
Exchange rate overvaluation	-0.0083**	-0.0092***	-0.0084***	-0.0083**	-0.0079***	-0.0079***	-0.0076***	-0.0083***	-0.0078***	-0.0079***	-0.0077***	-0.0073*
	(-1.99)	(-1.87)	(-1.68)	(-2.03)	(-1.79)	(-1.84)	(-1.69)	(-1.64)	(-1.79)	(-1.82)	(-1.71)	(-1.64)
Black market premium		0.0019	0.0008					0.0018				
		(0.59)	(0.22)					(0.54)				
Term of trade growth	0.0886		0.0872				0.0789					
	(1.05)		(0.92)				(0.92)					
Endowments variables												
Landlock					-0.0004							
					(-0.10)							
Ln1 100						-0.0011						
						(-0.29)						
Instruments:												
Constructed trade share	No	No	No	No	No	No	Yes	Yes	No	Yes	Yes	Yes
Legal origin	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Ethnolinguistic fraction	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
F. P. S. E.(1)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes
F. P. S. W. E.(2)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes
Distance(3).	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
R-squared	0.67	0.66	0.65	0.67	0.66	0.67	0.65	0.71	0.62	0.62	0.68	0.68
Number of observations	72	71	71	77	71	73	71	73	74	74	75	75

Notes: *t* tests are in brackets. *, **, *** Significant at 1% , 5% and 10% respectively.
(1) Fraction of the population speaking English. (2) Fraction of the population speaking one of the major languages of Western Europe. (3) Distance fr
capital city.

TABLE A.3
ROBUSTNESS CHECK FOR GROWTH VOLATILITY EQUATIONS
Dependent Variable: Std. Deviation of GDP per capita Growth

	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)
Institutions	-0.0082**	-0.0076**	-0.0075**	-0.0110*	-0.0118*	-0.0170**	-0.0159**	-0.0104*	-0.0095*	-0.0108*	-0.0105*	-0.0109*
	(-2.34)	(-2.04)	(-1.99)	(-4.45)	(-5.60)	(-2.02)	(-1.94)	(-5.40)	(-4.21)	(-5.10)	(-5.42)	(-4.86)
Others Controls:												
Financial development	-0.0040	-0.0041	-0.0039			0.0097	0.0083					
	(-1.08)	(-1.11)	(-1.04)			(0.80)	(0.74)					
Government consumption			0.0058					0.0045	0.0049		0.0045	
			(1.21)					(0.96)	(1.00)		(0.95)	
Exchange rate overvaluation	0.0188*	0.0182*	0.0181*	0.0186*	0.0200*	0.0217*	0.0219*	0.0194*	0.0170*	0.0219*	0.0194*	0.0208*
	(3.42)	(3.31)	(3.17)	(2.76)	(3.61)	(3.00)	(3.00)	(3.79)	(3.02)	(3.82)	(3.79)	(3.74)
Inflation	-0.0002		-0.0002			0.0015			0.0008			
	(-0.12)		(-0.11)			(0.77)			(0.53)			
Openness1	0.0035	0.0026	0.0023			0.0121***	0.0102	0.0071***	0.0078***		0.0070***	
	(1.01)	(0.75)	(0.64)			(1.75)	(1.58)	(1.71)	(1.65)		(1.66)	
Openness2										0.0057		
										(0.91)		
Term of Trade Volatility		0.0001	0.0001	0.0001			0.0001		0.0001			
		(0.75)	(0.89)	(0.90)			(0.58)		(0.53)			
Government Consumption Volatility				0.0641								
				(0.67)								
Inflation Volatility				0.0004								
				(-0.79)								
Instruments:												
Constructed trade share	No	No	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	No
Legal origin	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Ethnolinguistic fraction	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
F. P. S. E.(1)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	No	No
F. P. S. W. E.(2)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	No
Distance(3)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.52	0.53	0.54	0.48	0.45	0.31	0.35	0.49	0.50	0.44	0.49	0.46
Number of observations	74	73	73	84	85	74	73	76	75	82	76	85

Notes: *t* tests are in brackets. *, **, *** Significant at 1% , 5% and 10% respectively.
(1) Fraction of the population speaking English. (2) Fraction of the population speaking one of the major languages of Western Europe. (3) Distance fro
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Capitalización Heterogénea de un Bien Semipúblico: El Metro de Santiago*

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In this work we estimate the degree of capitalization of the Santiago Subway (Metro) network housing prices, analyzing price the differences among lines and counties. For this purpose, we combine hedonic price regressions with simple difference estimators. The results show that apartments located near the Metro stations have, on average, a larger value of 8.84%, 27.16 6.72% for Lines 1, 2, and 5 respectively. The degree of capitalization is not uniform within a but depends on the distance to the subway station and the specific line providing the service.

Keywords: Metro, Valor Departamentos, Capitalización Diferenciada.

Este trabajo estima el grado de capitalización del acceso a la red de Metro de Santiago en el las viviendas, investigando las diferencias por línea y por comuna. Para ello, se combinan reg hedonicas con estimadores de diferencia simple. Los resultados muestran que departamentos localizados en el área de influencia del Metro presentan un mayor valor promedio de 8,84%, y 6,72% para las Líneas 1, 2 y 5 respectivamente. El grado de capitalización al interior de un comuna no es uniforme sino que depende de la distancia a la estación y la línea que provee e servicio.

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1. INTRODUCCIÓN

En general, las viviendas que por su ubicación poseen mejores accesos tienen un valor de me

superior respecto a aquellas de características similares pero con malos accesos. Este diferen precios se debe, principalmente, a los menores costos de transporte hacia los principales mer laborales y comerciales de una ciudad. De esta forma, uno de los efectos que tanto la teoría públicos como la de terrenos urbanos predicen respecto a los beneficios de las facilidades y s públicos de transporte, es que estos se capitalizan total o parcialmente en el precio de los ter las viviendas (Henneberry, 1998; Oakland, 1987; Rubinfeld, 1987)[1].

La literatura empírica, sin embargo, no presenta evidencia sistemática respecto al signo de la existente entre la cercanía a una facilidad de transporte y el valor de las propiedades. Por un estudios de Dewees (1976), Damm *et al.* (1980), Bajic (1983), Voith (1991), Grass (1992), Mosaind *et al.* (1993), Debrezion, Pels y Rietveld (2003) encuentran efectos positivos para tr metro en distintas ciudades de Estados Unidos y Canadá. Por otro lado, los estudios de Dornb (1975), Armstrong (1994), Bowes and Ihlanfeldt (2001) muestran efectos negativos para el t último, Gatzlaff *et al.* (1993) no encuentran evidencia de que exista algún efecto en el caso d anuncio de un nuevo sistema de trenes de Miami.

La mayoría de los trabajos teóricos y empíricos asumen que los impactos de las facilidades y públicos de transporte son uniformes en el área de servicio. Sin embargo, éste depende tanto distancia de la propiedad al acceso a la red de transporte público como de las diferentes valo que tienen los individuos por las distintas características del servicio, en cuyo caso sus efecto distribuirían de manera uniforme a lo largo de la zona de servicio[2]. De esta forma, la heterog de las preferencias por bienes públicos, las distintas calidades de servicio[3], las características socioeconómicas de los individuos y la escasez relativa de cada uno de los atributos del servi implican impactos diferenciales en el valor de las propiedades.

En la ciudad de Santiago, el Metro constituye, sin duda, una de las inversiones más importan materia de infraestructura pública de transporte. En la actualidad, las cuatro líneas en funcio cuentan con 90 estaciones, más de 85 km de rieles y satisfacen una demanda de 1.190.000 diarios. Dentro de la red de Metro actualmente en funcionamiento, las líneas 1, 2 y 5 ya se encuentran completamente consolidadas con más de 10 años de operación, lo cual permite u una metodología de precios hedónicos para estimar la capitalización del Metro en el valor de viviendas.

Este trabajo tiene dos objetivos. En primer lugar, identificar el grado de capitalización de las 2 y 5 del Metro en el precio de las propiedades.

En segundo lugar, identificar y cuantiñcar la presencia de heterogeneidad en el grado de capitalización entre comunas. Específicamente, en este caso el objetivo es determinar empíri si dos viviendas localizadas a una misma distancia de la estación de Metro y con idénticos atr estructurales, dada la comuna y la línea de servicio, presentan el mismo grado de capitalizaci

En particular, utilizando una base de datos única, con precios de mercado efectivos para las viviendas, y una metodología de regresiones de precios hedónicos, este trabajo estudia las di en el grado de capitalización del acceso para las líneas 1, 2 y 5 de la red del Metro de Santiag precio de las viviendas.

Los resultados empíricos muestran un grado importante de capitalización para las líneas del M Santiago. Los departamentos localizados en el área de influencia del Metro presentan un may promedio de 8,84%, 27,16% y 6,72% para las Líneas 1,2 y 5 respectivamente. Más aún, los resultados muestran que la distribución del grado de capitalización al interior de una comuna uniforme, sino que depende de dos características: la distancia a la estación y la línea de Met provee el servicio. Es así que en la comuna de Providencia las viviendas dentro del área de in de la Línea 1 y 5 muestran un mayor valor del orden de 12,2% y 4,1% respectivamente, mie que en la comuna de Santiago las viviendas localizadas dentro del área de influencia de las Li 2y 5 del Metro presentan un mayor valor del orden de 16,9%, 10,2% y 11,6% respectivame

El resto del artículo continúa de la siguiente forma: en la sección 2 se presenta una breve des

del Metro en la ciudad de Santiago; en la sección 3 se desarrolla un modelo simple de capital
en la sección 4 se discute la identificación del efecto del Metro en el valor de las viviendas; er
sección 5 se describen los datos utilizados en el análisis empírico. Los resultados de las estim
se discuten en las secciones 6 y 7, diferenciando los impactos directos de la capitalización del
de aquellos indirectos. Finalmente la sección 8 concluye.

2. El METRO DE SANTIAGO

En el año 1969 se diseñó para Santiago una red de Metro como eje articulador del sistema de
transporte de la ciudad. Dicho plan tenía siete líneas de Metro que se construirían de acuerdo
evolución de la demanda. En 1975 comenzó a funcionar el primer tramo Moneda-San Pablo,
correspondiente a la Línea 1. Posteriormente, la Línea 1 se extendió hasta la Escuela Militar e
se construyeron las Líneas 2 y 5, que comenzaron a operar en 1987 y 1997 respectivamente.
tres líneas de la red tienen 49,6 km de rieles, 60 estaciones y en el año 2005 se realizaron 9
viajes diarios en promedio durante los días laborales.

En mayo de 2001, el gobierno anunció un nuevo plan de inversiones para solucionar los prob
transporte urbano en la ciudad de Santiago. Este plan, denominado Transantiago, consiste er
reorganización del plan de transporte público a través de un sistema integrado de transporte
incluye nuevos buses así como vías segregadas para ellos y que tiene como eje estructural la
Metro[4].

Como articulador del nuevo sistema de transporte, el Metro tiene en él un rol primordial, por
plan Transantiago considera inversiones importantes para mejorar y extender la red. Las inve
en la red de Metro, en el corto plazo, consistieron en extender las Líneas 2 y 5[5] y en construi
4[6]. Las extensiones de las Líneas 2 y 5 se encuentran en operación desde el cuarto y el prime
trimestre del año 2004 respectivamente, y la Línea 4 comenzó a operar parcialmente el cuart
trimestre del año 2005 y completamente el tercer trimestre del 2006.

Por último, el 15 de noviembre de 2005 el gobierno anunció la extensión de la Línea 1 hasta
Dominicos así como la construcción de una nueva línea hasta la comuna de Maipú. Las nueva
requerirán una inversión aproximada de 900 millones de dólares. El proyecto de extensión de
1 cuenta con 4 kilómetros rieles y 4 nuevas estaciones; mientras que el de Línea Maipú cuent
13,5 kilómetros de rieles y 13 estaciones. La demanda estimada para estos nuevos proyectos
orden de 254.000 pasajeros por día.

3. BIENES PÚBLICOS, COSTOS DE TRANSPORTE Y EL VALOR DE UNA VIVIENDA

La disposición a pagar de un consumidor por una vivienda depende tanto de las característica
vivienda como de su ubicación. Esto último tiene un efecto importante fundamentalmente por
razones: el acceso a bienes públicos locales y los costos de transporte.

En primer lugar, la ubicación de una vivienda determina el nivel de bienes públicos locales qu
pueden consumir sus residentes. Una de las características de los bienes públicos o semipúbli
locales es que su consumo está atado al consumo de tierra y es precisamente esta caracterís
que produce la capitalización del valor del bien público en las propiedades o los terrenos (Oak
1987). Como se mencionó anteriormente, el grado en el cual esta capitalización ocurre deper
entre otras cosas, de la heterogeneidad de las preferencias de los residentes por el bien públi
(Rubinfeld, 1987). Por ello, dadas sus características, el precio de mercado de una vivienda r
valoración marginal a pagar de todos los potenciales compradores de viviendas en el área de
un conjunto de bienes públicos (Yinger, 1982; Rubinfeld, 1987). Si bien el grado de heteroge
en las preferencias por los bienes públicos locales determina el grado de capitalización, la evi
empírica muestra que su valorización promedio tiende a capitalizarse en forma importante en
precio de las viviendas (Gramlich y Rubinfeld, 1982).

En segundo lugar, la ubicación de una vivienda determina los costos de transporte en que del incurrir sus residentes para trasladarse a sus lugares de trabajo, estudio y consumo. Dadas la características de una vivienda y el nivel de bienes públicos a los que tienen acceso sus resid precio de mercado refleja el tiempo y la distancia a los principales mercados laborales y de intercambio de bienes en una ciudad (Von Thünen, 1863; Alonso, 1964; Milis, 1967 y Muth, 1

El Metro constituye un bien semipúblico que reduce los costos de traslado hasta los principale centros de trabajo y comercio de la ciudad de Santiago. Por las dos razones mencionadas, un efectos esperados es que la demanda por viviendas se concentre en las zonas geográficas cer las líneas del Metro. Dado que la oferta de terrenos en el área relevante está fija en el largo p aumento de la demanda debería traducirse en un aumento en el valor de las tierras y viviend cercanas a las líneas de Metro. Dicho aumento debería ser función de la distancia entre las vi y terrenos y las nuevas estaciones del Metro.

Al igual que en el caso de una demanda por un bien privado con algún grado de diferenciació horizontal, la heterogeneidad de las preferencias y características individuales determinan dif en la disposición a pagar por el bien. En el caso del Metro de Santiago, existen además comp de diferenciación vertical entre las líneas, ya que los tiempos de espera y la densidad de pasa varían en forma importante entre ellas. Como resultado de estos componentes de diferenciac grado de capitalización de un bien semipúblico como el Metro debiera variar fuertemente entr de individuos con diferentes características. Si bien no existen datos que permitan observar la particularidades de los propietarios de las viviendas, la teoría de Tiebout (1956) respecto a la localization espacial de los individuos de acuerdo a sus preferencias por bienes públicos locale permite considerar empíricamente un grado de capitalización diferenciada por comunas.

3.1 Un modelo simple de capitalización diferencial

En esta sección presentamos un modelo, adaptado de Rosen (1974), para mostrar la existen diferencias en el grado de capitalización del acceso explícitamente.

Definamos la función de oferta de viviendas como:

$$(1) \qquad \delta = \delta(z_i, t)$$

donde z_i es un vector de atributos de la propiedad y t es el tiempo. La oferta de propiedades determinados atributos estructurales y de localization para un momento de tiempo está fija.

Por otra parte, definamos la función de demanda del individuo, θ, como el valor máximo que dispuesto a pagar por una vivienda de atributos zi, esto es:

$$(2) \qquad \theta = \theta\left(z_i; I, \alpha\right)$$

donde z_i representa el vector de atributos de la propiedad, I es el ingreso del individuo y «rep las preferencias del mismo.

Derivando respecto de zi obtenemos la disposición marginal a pagar por el atributo i, esto es

$$(3) \qquad \frac{\partial \theta}{\partial z_i} = \theta_{z_i}\left(z_i; I, \alpha\right)$$

Como puede observarse en la ecuación (3) la disposición marginal a pagar por el atributo i depende del nivel de ingreso y de las preferencias del individuo, $\frac{\partial^2\theta}{\partial z_i \partial I} = \theta_{z_i,I}(z_i; I, \alpha)$ y $\frac{\partial^2\theta}{\partial z_i \partial \alpha} = \theta_{z_i,\alpha}(z_i; I, \alpha)$. Dada una combinación particular de

atributos, si permitimos que varíe el nivel de ingreso o las preferencias obtenemos una distrib para la disponibilidad marginal a pagar por el atributo *i.* En consecuencia, dado que la oferta atributos para un momento en el tiempo es fija, las diferencias en las preferencias y en los in de los individuos implican diferencias en el grado de capitalización del acceso en el precio de viviendas. En equilibrio, se observa una segmentación del mercado inmobiliario acorde a las preferencias e ingresos de los agentes económicos (Tiebout, 1956).

Este modelo simple nos entrega una predicción empíricamente testeable; dos viviendas idént localizadas a una misma distancia de la facilidad de transporte y de los mercados relevantes términos de desplazamientos no necesariamente presentan el mismo grado de capitalización acceso a dicha facilidad.

Es importante destacar que la evidencia empírica en la literatura económica, tal como lo pred teoría, muestra que los determinantes del precio de una vivienda son: las características de l (número de habitaciones, antigüedad, metros cuadrados, etc.), las peculiaridades del vecinda de criminalidad, ingreso promedio, calidad de las escuelas cercanas, etc.), y el paquete fiscal impuestos a la propiedad y bienes públicos provistos localmente (recolección de basura, prote policial, hospitales, etc.)[7].

En términos generales, la ecuación de precios de vivienda a estimar es la siguiente:

$$P(i) = \alpha + \pi X(i) + \delta L(i) + \tau D(i) + \varepsilon(i) \quad (4)$$

donde la variable dependiente *P(i)* es el precio de venta de la propiedad *i, X(i)* una matriz de estructurales de la vivienda (incluidos superficie, número de baños y dormitorios, etc.), *L(i)* e matriz que recoge características del entorno y de localization distintos del acceso a medios d transporte masivo (bienes públicos locales, áreas verdes, centros comerciales, colegios y escu clínicas y hospitales), *D(i)* es una matriz que recoge variables relevantes desde el punto de vi acceso a servicios de transporte y, por último, *ε(i)* es el término del error.

La estimación de la ecuación (4) es equivalente a una regresión de precios hedónicos (Rosen, Bartik, 1987, y Freeman, 1979), que captura la valoración media que otorgan los consumidor cada característica particular de la vivienda y su entorno[8].

4. IDENTIFICACIÓN

Una estimación de precios hedónicos como la ecuación (4) permite estimar la valoración mar promedio de los consumidores por el acceso al Metro. Para ello basta con definir la matriz *D* d distancia o el tiempo de desplazamiento a la estación de Metro más cercana. De esta forma, posible identificar la capitalización del acceso, estimando cómo varía el precio de la vivienda a aumentar la distancia a la estación de Metro o estimando la diferencia en precio de las vivien se encuentran dentro del área de influencia del Metro respecto de aquellas que no. Este ejerc permite identificar el impacto de la facilidad de transporte en el precio de las viviendas.

Tal como se señaló previamente, uno de los objetivos de este trabajo consiste en identificar e de capitalización del Metro de Santiago en el precio de las viviendas. Para ello se realizan dos ejercicios empíricos relevantes. El primero, permite identificar diferencias en el grado de capi por línea de servicio del Metro. El segundo, permite identificar diferencias en el grado de capitalización por comuna y al interior de la misma por línea de servicio.

Para efectos de discutir la identificación del impacto del Metro en el precio de las viviendas, consideremos primero el caso de una única línea. Definamos la vivienda *s* localizada a una dis razonable (caminable) de desplazamiento hasta la estación del Metro y la vivienda *t* fuera de influencia del área del Metro. Si ocurre algún grado de capitalización, después de haber contr por todos los otros factores relevantes, observaríamos que el precio de una vivienda *s* es sup precio de la vivienda *t.* Para cuantificar el valor de la externalidad que genera el trazado de la del Metro sobre el precio de una vivienda particular, se debe determinar cuál es el precio la v si no se encontrara en el área de influencia del Metro, o de la vivienda *t* si se encontrara en e influencia, es decir, es necesario construir un contrafactual[9]. Dado que no es posible observa misma vivienda en ambos estados de la naturaleza, la solución teórica a este problema consis encontrar viviendas de control, las cuales tienen en promedio características similares (tipo d vivienda, metros cuadrados construidos, número de habitaciones y baños, orientación, etc.) a estamos estudiando pero están ubicadas en un área donde el trazado de la línea del Metro no influencia. De esta forma, el estimador que permite calcular la capitalización en el precio de u vivienda *i* en la comuna; es un estimador simple de diferencias a partir de la siguiente regres

$$(5) \qquad P(i,j) = \theta + \pi X(i,j) + \delta L(i,j) + \tau_j D(i,j) + \varepsilon(i,j)$$

donde:

$$(6) \qquad \tau_j = \left\{ E\left[P(i,j) \middle| X(i,j), D(i,j) = 1 \right] - E\left[P^C(i,j) \middle| X(i,j), D(i,j) = 0 \right] \right\}$$

La interpretación de este estimador, que se obtiene a través de modificar la regresión hedóni especificada en (4), es simple pero importante para los efectos de este trabajo: τ_j es la difere entre la valoración media de la distancia de las viviendas que se encuentran cerca de la estac Metro respecto de la valoración media de la distancia de aquellas viviendas fuera del área de influencia del Metro en la comuna *j*.

Tal como se discutió previamente, hay razones teóricas importantes para considerar que el g capitalización del acceso en el precio de las viviendas no es uniforme, incluso para localizacio similares tiempos de traslado a la estación de Metro más cercana. La valoración marginal de consumidores por el acceso al Metro depende, entre otros factores, de la percepción de la cal servicio, el grado de agrupamiento de individuos que presentan similares preferencias por la bienes públicos, la concurrencia de la oferta como determinante de la escasez relativa de dic localization en el corto plazo y los procesos de autoselección de los individuos.

Para efectos de discutir las diferencias del impacto por línea de Metro en el precio de las vivie consideremos ahora el caso de una única comuna. Definamos las viviendas *i j* localizadas am una distancia razonable de desplazamiento hasta la estación de Metro más cercana correspor las líneas *t* y *s,* respectivamente. Para identificar la existencia del algún diferencial en el grad capitalización entre las viviendas, es necesario construir nuevamente un contrafactual. El sigu estimador permite identificar la existencia de diferencias en el grado de capitalización del acc considerando las distintas líneas que sirven a una comuna particular:

$$(7) \qquad \alpha = \left\{ E\left[P^s(i,t) \middle| X(i), D(i,j) = 1 \right] - E\left[P^s(i,t) \middle| X(i), D(i,j) = 0 \right] \right\} - \left\{ E\left[P^t(j,t-1) \middle| X(j), D(i,j) = 1 \right] - E\left[P^t(j,t-1) \middle| X(j), A = 0 \right] \right\}$$

La interpretación de este estimador, obtenido al modificar nuevamente la regresión hedónica especificada en (5), es equivalente a la anterior: el cambio medio en la valoración marginal d distancia de las viviendas que se encuentran servidas por la línea *s* del Metro respecto del ca medio en la valoración marginal de aquellas viviendas servidas por la línea *t* del Metro.

Utilizando la base de datos que se describe en la próxima sección, se estiman regresiones cor explicitada en la ecuación (5), lo que permite obtener estimadores consistentes de (6) y (7)[1

5. DATOS

Para el análisis empírico utilizamos la base de datos del Conservador de Bienes Raíces de San Esta es una base de datos única, que contiene todas las transacciones inmobiliarias realizada Gran Santiago y a la cual tuvimos acceso para el período entre diciembre de 2000 y abril de 2 Cada observación consiste en el precio de venta de la vivienda, un conjunto de variables que describen los atributos físicos de la propiedad y su localization geográfica (coordenadas Este-

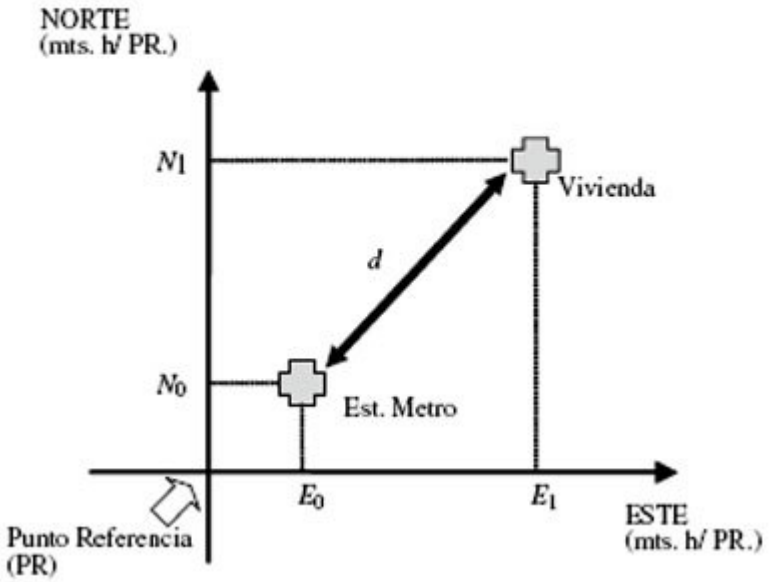
Lamentablemente, en la base de datos la información sobre atributos físicos en el caso de las muy limitada. Por esta razón decidimos utilizar sólo los datos de transacciones de departame cuales cuentan con información detallada de sus características. Existen 23.470 transaccione departamentos registradas en las comunas de La Florida, Las Condes, Macul, Ñufioa, Provide Quinta Normal, San Miguel y Santiago durante este período. Es importante mencionar que du período de la muestra no hubo cambios en los planes reguladores de las comunas considerad la excepción de Las Condes, que lo modificó en diciembre de 2003.

Para cada uno de los departamentos, calculamos la distancia a cada una de las 55 estaciones red de Metro (24 correspondientes a la línea 1, 19 a la Línea 2 y 17 a la Línea 5) de la siguier forma:

Utilizando el mapa digital de Santiago de Mapcity se georreferenciaron[13] las estaciones del Me Santiago correspondientes a las Líneas 1, 2 y 5.

Se calculó la distancia euclidiana *(d)* entre cada vivienda y las estaciones del Metro:[14]

DIAGRAMA 1



El Cuadro 1 presenta un resumen estadístico de las variables utilizadas en la estimación. La v dependiente es el precio del departamento medido en unidades de fomento (UF)[15]. Como var independientes se utilizan tres grupos de variables.

CUADRO 1
VARIABLES UTILIZADAS EN LA ESTIMACION ECONOMETRICA

Variable	Media	Desviación Estándar	Mín.	Máx.
Precio de Transacción (UF)	2.695,00	2.096,00	201	29.880
Superficie (metros cuadrados)	79,00	46,00	20	943
Antigüedad (años)	7,00	11,00	0	91
Beneficio Tributario DFL2 (BT_DFL2)	0,11	0,32	0	1
Dormitorios (número)	2,37	1,00	1	24
Baños (número)	1,83	0,73	1	16
Estacionamientos (*dummy*) (variable dicotómica)	0,67	0,73	0	8
Bodegas (*dummy*)	0,61	0,53	0	12
Ascensor (*dummy*)	0,87	0,33	0	1
Distancia Clínica más Cercana (metros)	611,00	526,00	11	4.185
Distancia Hospital más Cercano (metros)	2.188,00	1.943,00	20	12.097
Distancia Colegio más Cercano (metros)	281,00	283,00	10	3.161
Distancia Area Verde más Cercana (metros)	312,00	253,00	15	2.882
Calle (*dummy*)	0,26	0,44	0	1
Avenida (*dummy*)	0,73	0,45	0	1
Pasaje (*dummy*)	0,02	0,13	0	1
Cambio Stock (unidades)	28.353,00	1.722,00	24.046	31.904
Distancia Estación de Metro más Cercana (metros)	965,00	1.079,00	14	9.426
D1000 (*dummy*)	0,68	0,47	0	1

En primer lugar, se considera un conjunto de variables que capturan las características estruc de cada departamento: superficie en metros cuadrados, antigüedad, número de dormitorios, de baños, número de bodegas, número de estacionamientos, si tiene ascensor, si recibe el be tributario de DFL 2[16] o no y si el edificio está ubicado en una calle o en una avenida. Se inclu además la variable cambio stock que recoge la evolución de la oferta de departamentos nuev Gran Santiago[17]. El objetivo de esta última variable es capturar posibles efectos de oferta en mercado inmobiliario que afectarían los precios promedio de las viviendas en todo Santiago.

En segundo lugar, se considera un conjunto de variables que capturan el acceso a bienes púb semipúblicos. Adicionalmente a la distancia a la estación de Metro más cercana, calculamos la distancia euclidiana entre cada departamento y el colegio, el hospital, la clínica y el área verd cercanos. Para ello se consideraron los 893 colegios, 8 hospitales, 52 clínicas y 821 áreas ver existentes en las comunas relevantes.

En tercer lugar, se consideran un conjunto de variables indicadoras *(dummies)* equivalentes a fijos por comuna, por mes y por año.

En cuarto lugar, se generó la variable *dummy* DI000 que permite capturar el grado de capital del Metro en el precio de las viviendas. Esta variable asume el valor 1 para las viviendas dent área de influencia del Metro (1.000 metros) y el valor 0 en otro caso. El coeficiente estimado esta variable constituye el estimador simple de diferencias de la ecuación (6)[18].

Adicionalmente, la *dummy* DI000 se interactúa con la variable Distancia al Metro para captur cambio en el valor del departamento, de acuerdo a la distancia a la estación más cercana. Si espera que el valor de las propiedades disminuya a medida que se encuentran ubicadas más Metro, es posible que para departamentos muy cerca de las estaciones su valor aumente al a un poco ya que disminuye el ruido y el flujo de personas y comercio en los alrededores (Duek

y Rufolo, 1998)[19].

Por último, la variable DI000 se interactúa con una variable dicotómica *(dummy)* que indica a línea corresponde la distancia entre el departamento y la estación de Metro más cercana. El coeficiente estimado para esta variable corresponde al estimador de diferencia en diferencias ecuación (7).

6. RESULTADOS

Los Cuadros 2 y 3 muestran los resultados de la estimación de la ecuación (4). Esta estimaci permite cuantiñcar tanto el grado de capitalización que presentan las distintas líneas del Metr Santiago como el grado de capitalización del Metro para las comunas de Las Condes, Ñuñoa, Providencia y Santiago.

CUADRO 2
ESTIMACION POR LINEA DE METRO
Variable dependiente: precio de transacción

Variables	L1		L2		L5	
	Modelo 1	Modelo 2	Modelo 1	Modelo 2	Modelo 1	Modelo 2
Antigüedad	-40,657*	-41,69*	-18,944*	-19,106*	-16,007*	-17,372*
BT_DFL2	111,404*	106,02*	-135,668	-134,076	-103,784*	-127,736*
Superficie	37,619*	37,614*	33,956*	33,955*	18,862*	18,857*
Dormitorios	-265,489*	-265,957*	-142,538*	-143,906*	7,771	12,665
Baños	134,404**	142,339**	-115,563**	-113,089**	208,979*	206,082*
Estacionamientos	359,792*	356,919*	258,754*	260,156*	164,284*	162,682*
Bodegas	-161,589*	-161,35*	-1,907	-2,09	151,698*	153,907*
Ascensor	-121,306*	-122,768*	267,206*	254,728*	113,86*	102,619*
Clínica	0,05	0,057	-0,11	-0,095	-0,112*	-0,083*
Hospital	0,136*	0,135*	-0,1*	-0,115*	0,057	0,065
Colegio	0,527*	0,533*	-0,382*	-0,477*	0,053	0,059
Area Verde	-0,208*	-0,199*	0,534*	0,553*	0,01	-0,045
Cambio *Stock*	-0,005	-0,004	0,032	0,032	0,008	0,003
DI000	253,472*	429,881*	439,804*	395,576*	125,326*	388,802*
DI000*Distancia		-0,268*		0,135		-0,469*
Constante	428,221	404,204	-1651,699*	-1679,399*	-437,375	-341,164
Obs.	14.404	14.404	2.773	2.773	6.293	6.293
F	616,67	598,59	46,75	45,26	201,49	196,97
R^2	0,78	0,78	0,61	0,61	0,48	0,48

Nota: *, ** Estadísticamente significativo al 5% y 10% respectivamente. Todas las estimaciones incluyen variables dicotómicas que controlan por mes, año, vía y comuna.

CUADRO 3
ESTIMACION POR COMUNA
Variable dependiente: precio de transacción

Variables	Las Condes		Providencia		Santiago		Ñuñoa
	Modelo 1	Modelo 2	Modelo 1	Modelo 2	Modelo 1	Modelo 2	Modelo 1
Antigüedad	-81,428*	-81,515*	-38,891*	-38,172*	-15,114*	-15,275*	-28,91*
BT_DFL2	-6,854	-16,319	58,111	62,658	-1,525	-3,764	-99,813*
Superficie	39,333*	39,341*	25,913*	25,829*	25,032*	25,026*	28,953*
Dormitorios	-170,472*	-173,398*	12,453	13,472	-98,479*	-98,495*	8,999
Baños	141,61	145,232	30,816	24,872	160,51**	160,181**	37,113
Estacionamientos	278,875*	278,454*	169,456*	169,208*	341,005*	339,208*	-11,75
Bodegas	-182,319*	-179,31*	-40,267	-40,824	33,577	33,873	125,9*
Ascensor	-156,23**	-154,295**	-79,842*	-70,742*	20,187	21,085	216,039*
Clínica	-0,003	0,014	-0,063	-0,107	-0,022	-0,039	0,112**
Hospital	0,15*	0,147*	0,342*	0,355*	-0,072*	-0,053*	0,124*
Colegio	0,482*	0,498*	0,272*	0,269*	-0,149	-0,11	0,074
Area Verde	0,158	0,173	-0,012	-0,004	-0,258*	-0,269*	0,243*
Cambio *Stock*	-0,028*	-0,028*	0,018*	0,018*	0,007	0,006	-0,026
DI000	419,998*	665,472*	273,37*	217,506*	173,665*	212,013*	-8,873
DI000*Distancia		-0,28		0,114**		-0,111*	
Constante	683,751	699,921	-54,359	-48,716	-19,631	8,09	477,429
Obs.	7.325	7.325	4.664	4.664	8.461	8.461	1.546
F	290,44	282,81	148,26	145,23	135,17	131,59	205,06
R^2	0,77	0,77	0,7	0,7	0,58	0,58	0,58

Nota: *, ** Estadísticamente significativo al 5% y 10% respectivamente. Todas las estimaciones incluyen variables dicotómicas que controlan por mes, a

En cada uno de los dos casos (líneas y comunas) se consideran dos especificaciones distintas modelo 1 considera la variable *dummy* DI000 que asume el valor de 1 si la distancia a la esta Metro más cercana es inferior a 1.000 metros e igual a 0 en otro caso. El modelo 2 incorpora además, la interacción de la variable DI000 con la distancia a la estación de Metro más cerca

La especificación del primer modelo permite captar el grado de capitalización en los departam que se encuentran dentro de influencia de la línea del Metro, mientras que el segundo identifi tasa de caída del precio de la vivienda a medida que nos alejamos de la estación del Metro[20].

Adicionalmente, el Cuadro 4 presenta los resultados de la estimación de la ecuación (4) para identificar las diferencias en el grado de capitalización que presentan las distintas líneas de M sirven una misma comuna. Esta especificación incluye la variable DI000 y su interacción con variable *dummy* Línea; que asume el valor de 1 si la estación más cercana corresponde a la L 0 en otro caso.

CUADRO 4
IMPACTOS DIFERENCIALES POR COMUNA
Variable dependiente: precio transacción

Variables	Providencia		Santiago		
	L1	L5	L1	L2	L5
Antigüedad	-39,267*	-39,267*	-15,396*	-15,305*	-15,138*
BT_DFL2	55,675	55,675	3,889	6,083	-2,151
Superficie	25,899*	25,899*	24,983*	25,034*	25,018*
Dormitorios	17,136	17,136	-98,33*	-93,224*	-99,897*
Baños	29,625	29,625	163,822*	156,933**	162,413**
Estacionamientos	167,763*	167,763*	342,034*	340,144*	341,526*
Bodegas	-37,704	-37,704	27,529	36,259	31,171
Ascensor	-108,477*	-108,477*	34,638	34,557	20,166
Clínica	-0,061	-0,061	0,002	0,014	-0,026
Hospital	0,336*	0,336*	-0,087*	-0,064*	-0,079*
Colegio	0,149	0,149	-0,11	-0,147	-0,139
Area Verde	-0,053	-0,053	-0,248*	-0,243*	-0,259*
Cambio *Stock*	0,016*	0,016*	0,008	0,007	0,007
D1000	98,672*	295,186*	156,679*	212,058*	178,546*
Did L_j	196,514*	-196,514*	73,57*	-72,773*	-20,205
Constante	63,168	63,168	-87,205	-90,163	-18,607
Obs.	4.664	4.664	8.461	8.461	8.461
F	143,91	143,91	133,07	132,57	131,06
R^2	0,7	0,7	0,58	0,58	0,58

Nota: *, ** Estadísticamente significativo al 5% y 10% respectivamente. Todas las estimaciones incluyen variables dicotómicas que controlan por mes, año y vía.

6.1 Capitalización por Línea de Metro

En general, los resultados respecto a las características de los departamentos tienen los signo esperados y son bastante robustos a las distintas especificaciones. El Cuadro 2 muestra que l coeficientes estimados para las variables superficie construida y antigüedad son estadísticam significativos. Un metro adicional de superficie y un año adicional desde la construcción del e están asociados, en promedio, a un mayor precio de entre 18 UF y 37 UF y a un menor preci entre 16 UF y 41 UF, respectivamente dependiendo de la línea de Metro a la cual está más ce vivienda.

Los coeficientes estimados para el número de dormitorios, baños, bodegas y estacionamiento tiene ascensor si bien son estadísticamente significativos, sus signos varían dependiendo de l la cual está asociado el departamento. Así por ejemplo, puede parecer contraintuitivo que el coeficiente estimado para las variables dormitorio o baño sea negativo porque ambas variable asocian con el tamaño del departamento. Sin embargo, la interpretación del coeficiente estim dichas variables es más compleja cuando la estimación es condicional en la superficie constru departamento. La razón para esto es que en este caso un baño o un dormitorio adicional, manteniendo constante la superficie total construida, implica una reducción de los espacios destinados a living-comedor, cocina y dormitorios. El signo negativo para estos coeficientes p interpretarse como una mayor disposición a pagar por mayores espacios y no por un baño o habitación adicional[21].

Los resultados respecto al impacto que tiene la cercanía en el acceso a algunos bienes públic del todo satisfactorios. El coeficiente estimado para la distancia a la clínica más cercana sólo estadísticamente significativo y negativo para la Línea 5. Los coeficientes estimados para las que miden la distancia al hospital y el colegio más cercano presentan signo negativo y

estadísticamente significativo en el caso de la Línea 2, mientras que su signo es positivo en e
la Línea 1. Una posible explicación es que la calidad de estos servicios es más importante que
distancia a la cual se encuentran. En el caso de la variable que mide la distancia desde el
departamento hasta el área verde más cercana, sólo para la Línea 1 el coeficiente tiene signo
negativo y es estadísticamente significativo. Una explicación potencial es que no se controla p
calidad y el tamaño del área verde y los consumidores pueden preferir un parque más grande
más lejano a una plaza pequeña más cercana. Adicionalmente, para algunas comunas en la r
algunas áreas verdes constituyen lugares asociados a mayor delincuencia.

El cambio en el stock de viviendas disponibles no tiene un efecto estadísticamente significativ
precio de los departamentos.

Por último, el efecto del beneficio tributario del D.F.L. N° 2 es estadísticamente significativo,
en el caso de la Línea 2, y alterna signos positivos y negativos dependiendo de la línea. El ma
efecto ocurre porque el pago de dividendos se puede deducir de la base imponible del impues
renta. Los coeficientes estimados indican que el efecto final del menor costo relativo del crédi
uniforme, puede traducirse tanto en un aumento en la disposición a pagar por la vivienda, en
1, como una disminución de la misma, en el caso de las Líneas 2 y 5.

De especial interés es el coeficiente estimado para la variable DI000. Este estimador de difer
simple identifica el grado de capitalización del acceso al Metro en el precio de la vivienda por
de la comparación del valor medio de los departamentos que se encuentran dentro del área d
influencia del Metro respecto de aquellos que se encuentran fuera de ella. En todos los casos,
coeficientes estimados son positivos y estadísticamente significativos. Como puede apreciarse
Cuadro 2, el grado de capitalización en el precio de las viviendas varía dependiendo de la líne
Metro considerada. El estimador punto de la variable D1000 es de 125 UF, para la Línea 5; de
para la Línea 1; y 439 UF en la Línea 2, lo que equivale a una apreciación en el valor del
departamento promedio de 7%, 9% y 27% respectivamente.

Por otra parte, el coeficiente de la variable que interactúa las variables DI000 y Distancia, sól
casos de las Líneas 1 y 5 tiene un impacto negativo y estadísticamente significativo en el pre
departamentos, reflejando una distribución no uniforme en la capitalización del acceso. Tal co
predice la teoría, el aumento en el valor de un departamento disminuye al aumentar la distar
respecto a la estación más cercana del Metro. El coeficiente estimado muestra una disminuci
impacto del Metro de 0,27 y 0,47 UF, respectivamente, por cada metro que se aleja la ubicac
departamento respecto a la estación más cercana. Esto representa una tasa de depreciación
de 2,5% y 5,03% por cada 200 metros que se aleja una vivienda de la estación más cercana
correspondiente a las Líneas 1 y 5 respectivamente.

6.2 Capitalización por comuna

En esta sección se presentan los resultados de la ecuación (4) por comuna. Esta estimación p
cuantiñcar las diferencias en el grado de capitalización del Metro en el precio de los departam
análisis, por restricciones en el número de observaciones, se centra en las comunas de Las C
Providencia, Santiago y Ñuñoa.

Los coeficientes estimados para las variables estructurales, bienes públicos y acceso permiten
caracterizar los mercados inmobiliarios comunales. Al respecto, los resultados para los atribut
estructurales de la propiedad presentan los signos esperados y son robustos a las distintas
especificaciones del modelo. Como puede apreciarse en la Cuadro 3 los coeficientes estimado
las variables superficie construida y antigüedad son estadísticamente significativos. Un metro
adicional de superficie y un año adicional en la antigüedad de la construcción se asocian, en
promedio, a un mayor precio de entre 25 UF y 39 UF y a un menor precio de entre 15 UF y 8
respectivamente. Es importante destacar que en el caso de la comuna de Las Condes un año
de antigüedad se asocia con un menor valor medio de la propiedad del orden del 2,5%, mien
para las restantes comunas dicho porcentaje no supera el 1,4%.

El coeficiente estimado para el número de dormitorios es negativo y estadísticamente signific

para las comunas de Las Condes y Santiago. Es necesario recordar que cuando se controla po superficie construida, la mayor disposición a pagar se relaciona directamente con espacios ma amplios destinados a living, comedor, cocina, más que a habitaciones adicionales destinadas dormitorio. El coeficiente estimado para el número de baños es positivo y estadísticamente significativo sólo para el caso de la comuna de Santiago. El coeficiente estimado para la varia número de estacionamientos es positivo y estadísticamente significativo salvo en el caso de la comuna de Ñuñoa. Finalmente, el coeficiente estimado para la variable número de bodegas e positivo y estadísticamente significativo para la comuna de Ñuñoa, mientras que negativo y significativo para la comuna de Las Condes.

En relación con los resultados del impacto que tiene la cercanía en el acceso a algunos bienes públicos, es necesario realizar las mismas observaciones que para el caso de las líneas de Me

El coeficiente asociado a la variable cambio de stock de viviendas tiene un efecto negativo y estadísticamente significativo en el precio de los departamentos sólo para el caso de la Comu Las Condes. El menor valor medio asociado a un incremento de 1000 unidades del stock de v es 28 UF, equivalente a una depreciación del 1%. En cambio, en el caso de Providencia, el co estimado para la variable stock es positivo y estadísticamente significativo. Si bien este signo parecer contrario a lo esperado, hay que recordar que la variable cambio en el stock está con tanto por la oferta de departamentos, agregada para el Gran Santiago. Por lo tanto, la interp de esta variable no es equivalente a considerar el efecto que tiene un cambio en el stock para comuna específica. En efecto, un coeficiente con signo positivo indica que el cambio del stock comuna de Providencia fue menor que el cambio promedio para el Gran Santiago y, por lo tan un crecimiento agregado de la demanda, se observa una asociación positiva[22].

Por último, los coeficientes estimados para la variable D1000 son positivos y estadísticamente significativos para las comunas de Las Condes, Providencia y Santiago. El estimador punto de variable D1000 muestra que, en promedio, una vivienda localizada dentro del área de influen Metro se comercializa a un mayor valor de 173 UF en la comuna de Santiago; 273 UF, en Pro y 419 UF, en Las Condes, lo que equivale a una tasa de apreciación en el valor del departame promedio de 12,73%, 11,31%, y 13,5% respectivamente. Los coeficientes estimados para la de Ñuñoa no son estadísticamente significativos. Esta comuna recibe la influencia de la Línea Metro, la cual atraviesa una zona industrial y, por lo tanto, es posible que la capitalización de se produzca en los salarios más que en el precio de las viviendas.

La interacción de las variables DI000 y Distancia, sólo en los casos de las comunas de Santia Ñuñoa tiene un impacto negativo y estadísticamente significativo en el precio de los departam reflejando una distribución no uniforme en la capitalización del acceso. Tal como predice la te aumento en el valor de un departamento disminuye al aumentar la distancia respecto a la est más cercana del Metro. El coeficiente estimado muestra una disminución en el impacto del M 0,11 y 0,51 UF, respectivamente, por cada metro que se aleja la ubicación del departamento a la estación más cercana. En el caso de la comuna de Providencia, el coeficiente estimado pa variable es positivo y estadísticamente significativo. Este resultado tiene al menos dos explica alternativas. Primero, la relación entre el precio de la vivienda y la distancia a la estación de puede presentar no linealidades. Segundo, dicha variable indica un cambio en la calidad de lo departamentos a medida que nos alejamos de las estaciones de Metro.

Es importante señalar que los resultados de los Cuadros 2 y 3 son robustos tanto a especifica alternativas de cada modelo como a estructuras de error más flexibles. En particular, para de la posibilidad de problemas de correlación residual entre las líneas de Metro y entre las comu estimó para cada caso un sistema de ecuaciones utilizando la metodología SUR (Seemingly U Regressions). El test de Breush-Pagan de independencia de ecuaciones no rechazó la hipótesi la matriz de varianzas-covarianzas del sistema es diagonal.

Por último, se investiga la existencia de diferencias en el grado de capitalización del acceso e precio de las viviendas considerando las distintas líneas que proveen servicio en una misma c La comuna de Providencia está servida por las Líneas 1 y 5 y la comuna de Santiago por las l 2 y 5.

El Cuadro 4 presenta los resultados de estimar la ecuación (4) modificada para capturar las diferencias mencionadas.

En general, los resultados muestran diferencias en el grado de capitalización del acceso por lí tanto para Providencia como para Santiago. Los coeficientes estimados para la comuna de Pr muestran que una vivienda dentro del área de influencia de la Línea 1 y la Línea 5 presenta u valor del orden de 12,2% y 4,1 % respectivamente. Por otra parte, en el caso de la comuna Santiago los coeficientes estimados muestran que las viviendas localizadas dentro del área de influencia de las Líneas 1, 2 y 5 del Metro presentan un mayor valor del orden de 16,9%, 10, 11,6% respectivamente.

7. EFECTOS INDIRECTOS DE LA CAPITALIZACIÓN DEL ACCESO

Uno de los efectos indirectos importantes que potencialmente tiene la capitalización del Metro precio de las viviendas, es que al subir estas de valor aumentaría la recaudación del impuesto propiedades. Para que este efecto se materialice sólo es necesario que el Servicio de Impuest Internos reavalúe las propiedades en las comunas por las que pasa la red de Metro. Por ello e Metro ha planteado utilizar el aumento en la recaudación del impuesto territorial como una fo financiar la construcción de nuevas líneas de Metro[24].

El cambio en la recaudación en la comuna j (ΔR_j) se puede calcular como:

$$(8) \qquad \Delta R_j = \sum_{i=1}^{n} t_{vi} \times \Delta BI_{ij}$$

donde ΔBI es el cambio en la base imponible en la comuna; y t_{vi} es la alícuota impositiva, la función del valor de la propiedad[25].

Utilizando los resultados de nuestras estimaciones por comuna y la ecuación (8), estimamos potenciales cambios en la base imponible (avalúo fiscal) y en la recaudación por contribucion bienes raíces no agrícolas. Para estos efectos consideramos sólo los 14.623 departamentos d comunas de Las Condes, Providencia y Santiago que se encuentran a una distancia inferior a metros respecto de la estación de Metro más cercana.

En el Cuadro 5 se presentan los principales resultados para cada uno de los tres modelos esti por comuna, asumiendo que el avalúo fiscal de cada departamento aumenta en forma propor la capitalización del acceso a la red de Metro. En el caso I se asume que el aumento en el ava fiscal se realiza independiente de la distancia de cada departamento a la estación de Metro m cercana. En el caso II se asume que el aumento en el avalúo fiscal considera que el grado de capitalización depende de la distancia entre el departamento y la estación de Metro más cerc el caso III se asume que el aumento en el avalúo fiscal considera que el grado de capitalizaci interior de la cada comuna depende de la línea de Metro que provee el servicio.

CUADRO 5
CAMBIO PORCENTUAL EN LA RECAUDACION DEL IMPUESTO A LAS PROPIEDADES
(En porcentaje)

		Las Condes	Providencia	Santiago	Δ Medio Muestra
Caso I		12,60	14,36	14,22	13,73
Caso II		19,97	14,59	6,09	13,55
Caso III	L1		14,00	16,93	15,47
	L2			11,10	11,10
	L5		5,66	15,44	10,55

Tal como se aprecia en el Cuadro 5, la capitalización del valor del Metro en el precio de las vi puede producir un aumento en la recaudación por contribuciones pagadas por los departame la muestra de 13,73% si el reavalúo no considera la distancia al Metro, de 13,55% si conside mayor distancia del Metro la capitalización es menor y a entre 10,55% y 15,47% si permitim cambio en el avalúo depende de las diferencias en el grado de capitalización para las distinta al interior de la comuna.

Es importante señalar que el impacto estimado en la recaudación ha sido calculado para una de departamentos que corresponde a cerca del 18% de todos los departamentos que se encu dentro del área de influencia de las estaciones de Metro en las comunas de Las Condes, Provi Santiago. Si el impacto para el otro 82% de la población (75.109 departamentos en total seg 2002) es similar en promedio, el aumento en la recaudación total sería de entre U.F. 76.125 84.765 anuales.

Hay diversas razones para considerar estas estimaciones como un límite inferior de la magnit impacto en la recaudación. En primer lugar, la estimación asume que no se incorporarán nue proyectos inmobiliarios en los próximos 40 años. En segundo lugar, no se incorpora el aume valor de 28.404 casas nuevas y usadas dentro del rango de 1.000 metros de cada estación p comunas de Las Condes, Providencia y Santiago. En tercer lugar, no se considera el aumento recaudación por el mayor valor de las viviendas en las 18 comunas restantes que reciben la i de la red del Metro, esto es, 38.502 departamentos y 151.393 casas nuevas y usadas. Por úl se consideran tanto los departamentos como casas dentro del área de influencia de la nueva del Metro.

8. CONCLUSIONES

Las predicciones de la teoría de bienes públicos indican que los beneficios de las facilidades y públicos de transporte se capitalizan en el entorno. Por otra parte, el grado de capitalización homogéneo y depende de la distancia a la facilidad de transporte.

Si bien los estudios empíricos consideran el hecho de que el grado de capitalización de las fac y servicios de transporte depende de la distancia a la facilidad, suponen que dicho impacto se distribuye de manera uniforme para su área de cobertura.

El Metro de Santiago es una de las inversiones en infraestructura de transporte más importar Chile, no sólo porque satisface la demanda de transporte de casi 1,2 millones de personas po sino, además, por las inversiones involucradas en su desarrollo. La construcción de la Línea 4 extensiones de la Línea 2 demandaron 1.200 millones de dólares y las extensiones de la Líne Los Dominicos y la construcción de la nueva Línea hasta Maipú requieren una inversión de 90 millones de dólares, financiados en parte por el Estado y en parte por la Empresa Metro S.A.

Este trabajo utiliza una base de datos única para estudiar la valorización del entorno que gen Metro de Santiago en el precio de las viviendas. Utilizando una metodología que combina reg

hedónicas con la estimación de estimadores de diferencia simple, se estima el grado de capit del acceso a la red de Metro en el precio de los departamentos y se investigan las diferencias línea de servicio, en el grado de capitalización en el precio de los departamentos para una co particular.

Los resultados muestran un efecto importante de capitalización para las tres líneas del Metro Santiago. Los departamentos localizados en el área de influencia del Metro presentan un may promedio del orden de 8,84%, 27,16% y 6,72% para las Líneas 1,2 y 5 respectivamente. En adicional, los resultados muestran que el grado de capitalización al interior de una comuna no distribuye de manera homogénea, sino que depende de dos aspectos: la distancia a la facilid transporte y la línea de Metro que provee el servicio. Es así que en la comuna de Providencia viviendas dentro del área de influencia de las Líneas 1 y 5 presentan un mayor valor del orde 12,2% y 4,1% respectivamente, mientras que en la comuna de Santiago las viviendas localiz dentro del área de influencia de las Líneas 1, 2 y 5 del Metro presentan un mayor valor del or 16,9%, 10,2% y 11,6% respectivamente.

Cabe destacar que en este trabajo sólo se cuantiñca uno de los posibles impactos que tiene la Metro en la sociedad. Otros elementos a considerar son la reducción de la contaminación, la r eficiencia en la utilización de recursos combustibles, así como la capitalización en los salarios individuos que viven en las comunas por donde pasa el Metro (Roback, 1980 y 1982; Blomqu 1988; Gyourko y Tracy, 1989 y 1991).

Finalmente, los resultados de este trabajo plantean futuras líneas de investigación que deben exploradas. En particular, sería importante ampliar la base de datos a las casas con el objeto explorar el impacto diferencial que ocurre en los departamentos respecto a las casas. De igua sería importante conocer la evaluación *ex-ante* de una nueva línea de Metro para compararla evaluación *ex-post* que incluye el impacto de localization de nuevas viviendas.

NOTAS

* Los autores agradecen la información proporcionada por la empresa *Mapcity S.A.* La dispon de los datos contenidos en este estudio no es responsabilidad de Cuadernos de Economía. Investigadores interesados en obtener acceso a los datos para fines exclusivamente académi deben comunicarse directamente con los autores del estudio. E-mail: agostini@uahurtado.cl, gpalmucci@tdlc.cl

[1]Una de las características de los bienes públicos o semipúblicos locales es que su consumo e atado al consumo de tierra y es precisamente esta característica la que produce la capitalizac valor del bien público en las propiedades o los terrenos (Oakland, 1987).

[2]El grado de heterogeneidad de las preferencias afecta directamente el grado de capitalizació preferencias idénticas la capitalización es 100% y con mayor heterogeneidad disminuye (Rub 1987).

[3]En el caso del Metro de Santiago hay algunas diferencias importantes en la calidad del servic ofrece cada una de las líneas. En las horas punta, por ejemplo, los trenes pasan cada 97 segu la línea 1, 148 segundos en la línea 2 y 122 segundos en la línea 5, lo cual implica tiempos de distintos dependiendo de la línea que esté más cercana a la vivienda. Por otro lado, en las ho punta la densidad es de 5,1 pasajeros por m^2 en la línea 1, de 4,7 pasajeros en la línea 2 y d pasajeros en la línea 5 (Metro de Santiago, Memoria Anual 2005).

[4]La meta del gobierno con el plan Transantiago es la generación de un sistema de transporte que reduzca los niveles de congestión vehicular y contaminación atmosférica. Adicionalmente en forma integrada todos los modos de movilización pública disponibles, se espera mejorar la del servicio para los usuarios.

[5]Los proyectos de extensión de la Línea 2 (Norte y Sur y Extensión Recoleta) y de la Línea 5 con 11,9 kilómetros de rieles y 11 estaciones de Metro.

[6]La Línea 4 (Tobalaba-Vespucio-Puente Alto) cuenta con 33 kilómetros de rieles y se divide e tramo principal y uno secundario. Las proyecciones de demanda son de un aumento en la afl media diaria en la red de Metro del orden de los 324.000 pasajeros, es decir un 34,7% de los actuales.

[7]Ver, por ejemplo, Vesalti (1996) y Gibbons y Machín (2005).

[8]En equilibrio, los coeficientes estimados para una característica pueden interpretarse como l disponibilidad a pagar por un incremento marginal de dicha característica.

[9]Ver Rubín (1974), Rosenbaum y Rubín (1983), Angrist, Imbens y Rubín (1996) y Heckman, yTodd(1997).

[10]Ver Bajic (1983), Dewees (1976), Gatzlaffy Smith (1993), Lee (1973), McDonald y Osuji (1 McMillen y McDonald (2004). Si bien estos trabajos difieren en cuanto a la especificación del la idea conceptual consiste en comparar el cambio en el precio de las viviendas dentro del ár impacto del Metro con el cambio en el precio de las viviendas de control que no reciben el im Metro.

[11]Estos estimadores capturan el diferencial de precios existente entre las viviendas cercanas y las viviendas fuera del área de influencia del Metro.

[12]El Conservador de Bienes Raíces de Santiago registra todas las transacciones de viviendas, y terrenos que se realizan en el Gran Santiago. Esta base nos fue gentilmente proporcionada empresa *Mapcity S.A.*

[13]El proceso de georreferenciación consiste simplemente en asignarle un par de coordenadas Norte a cada observación.

[14] $\text{Distancia Vivienda - Metro} = d = \sqrt{(E_1 - E_0)^2 - (N_1 - N_0)^2}.$

[15]Unidad de fomento (U.E) es uno de los sistemas de reajuste autorizados por el Banco Centr Chile.

[16]El beneficio tributario de DFL 2 permite deducir el pago de dividendos de la base imponible impuesto a la renta. El tope es de 120 Unidades Tributarias Mensuales (UTM) al año si la vivi acogida al D.F.L. N° 2 fue adquirida antes del 31 de diciembre de 1999, 72 UTM si fue adquir el 1 de enero y el 30 de septiembre de 2000 y 36 UTM si se compra entre el 1 de octubre y e 30dejuniode2001.

[17]Información de la Cámara Chilena de la Construcción.

[18]Modelar explícitamente el área de influencia del Metro está fuera del ámbito de este trabajo embargo, estimaciones de Metro S.A. muestran que dentro del radio de 500 metros de la est Metro se capta en torno al 50-60% de la demanda y dentro de los 1.000 metros entre el 80-

[19]Por esta razón, los resultados de las estimaciones se deben interpretar como el efecto neto promedio de las propiedades.

[20]Los resultados presentados son robustos a la omisión simultánea de las variables que no so

estadísticamente significativas en cada modelo. Sin embargo, con el objeto de hacer compara estimaciones para distintas líneas de metro y distintas comunas, se prefirió mantener especif idénticas.

[21]Véase Clapp, J. (2003); Boxall, P., Chan, W. y McMillan, M. (2005); Boarnet, M. y Chalermp (2002); Landis, J., Guhathakurta, S. y Zhang, M. (1994).

[22]Idealmente, se debería incluir una variable de cambio en stock para cada comuna, pero no información disponible que permita hacerlo.

[23]Es posible que exista, por ejemplo, algún grado de correlación espacial entre los precios de departamentos para las distintas líneas y para las comunas adyacentes.

[24]"Una forma bastante inteligente de financiar el Metro sería que éste pudiera captar parte de plusvalía que genera y, con eso, pagar la construcción de nuevas líneas", Alvaro Caballero, G Comercial de Metro S.A., en Portalinmobiliario.com, 20/12/2005.

[25]Los predios no agrícolas destinados a la habitación gozarán de un monto de avalúo exento impuesto territorial de $ 10.878.522 al 1 de enero del 2005. La alícuota correspondiente a bi raíces no agrícolas destinados ala habitación es de 1,2 por ciento al año, en la parte de la bas imponible que no exceda de $ 37.526.739 del 1 de enero de 2005; y 1,4 por ciento al año, en de la base imponible que exceda del monto señalado.

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Metodología para Estimar un Índice Regional de Costo de Vivi en Chile*

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The aim of this article is to develop a methodology for a spatial or regional cost index of hous considers spatial differentials across regions. Using micro data from the Chilean survey CASE it is showed that a spatial or regional housing price index based on the weighted mean or the estimators of hedonic price equations might lead to biased results due to spatial heterogeneit potential bias is reduced by matching the houses in a region with a clone in the Metropolitan according to own and neighbors' characteristics using propensity scores. As a result a very di pattern of spatial cost of housing arises. Finally, using a Fisher ideal price index, the paper pr spatial or regional cost index of housing that shows price differences for homogeneous house regions.

Keywords: Housing Cost Index, Hedonic Prices Index, Matching Estimator, Spatial Fisher Inde

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El objetivo de este artículo es proponer una metodología para construir un índice regional de vivienda que tome en consideración la heterogeneidad espacial de éstas. Trabajando con la e CASEN 2003, se muestra que los precios promedios entre regiones así como la estimación de regresiones hedonicas pueden generar resultados sesgados producto de la heterogeneidad es Cuando se homogeiniza la muestra a través de método de pareo "matching", los resultados p cambian en forma significativa. Finalmente se construye un índice regional de costo de vivien captura las diferencias regionales en precios de arriendo de unidades homogéneas.

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1. INTRODUCCIÓN

El costo de vida para las regiones es una medida económica que debe estar disponible, a trav
número índice, para la formulación de políticas regionales y crecimiento económico balanceac
unidades geográficas. Formular políticas a nivel nacional, sin considerar aspectos económicos
relevantes a la dimensión regional, tales como los diferenciales en niveles de precios, puede f
erradamente los gastos asociados a éstas. Por ejemplo, actualmente la distribución del Fondo
Nacional de Desarrollo Regional (FNDR) considera, entre otros, el índice de Pobreza Regional
realizar su asignación, ignorando que este índice asume un costo de vida homogéneo para to
regiones del país. En consecuencia, las regiones más caras tienen asignaciones subestimadas
mientras las regiones más baratas tienden a beneficiarse en mayor medida de dichos fondos,
generando efectos inversos a los proyectados por el FNDR.

El principal efecto del aumento en el costo de vida es la disminución en el poder adquisitivo d
consumidores. Esta disminución no es espacialmente homogénea, sino que está afectada por
elementos endógenos a cada región, tales como la geografía, relaciones de intercambio, desa
los mercados locales, etc. Es por ello que el costo de vida juega un rol importante en la evalu
impacto que provocan las políticas de desarrollo económico regional destinadas a disminuir
disparidades entre regiones. En este sentido, aquellas regiones más baratas podrían tener ve
desarrollo sobre aquellas más caras. Es más, ignorar estas ventajas en el diseño de políticas
que el mercado las regule podría aumentar las desigualdades, generando un proceso de creci
divergente, que se manifieste en relaciones centro-periferia o clubes de desarrollo (Krugman,

Considerando lo anterior, el costo de vida debe ser enfocado desde una perspectiva espacial.
acuerdo a este concepto, una comparación adecuada entre unidades espaciales requiere calcu
índice superlativo[1] que considere los consumos de cada una de las regiones. Esto es relevant
país como Chile, donde la heterogeneidad geográfica es un elemento que modifica las estruct
consumo a lo largo de él. Por ello, un índice de costo de vida debe reflejar la estructura de
preferencias de los individuos en su entorno geográfico. Las consecuencias de mantener un ín
base a una realidad promedio nacional o a una región como es el caso de Chile (es decir, sin
considerar la heterogeneidad) subestimarán o sobrestimarán el verdadero costo de vida regio

La construcción de un índice regional de costo de vida considera diversos grupos de gastos, l
dependen de una multiplicidad de factores, entre ellos la realidad de la región, la estructura d
preferencias de sus consumidores, etc. En este artículo se estudiará uno de estos grupos: la v
Existen dos motivos para esta elección: en primer lugar la adquisición de una vivienda[2] puede
ser la inversión más importante del sector doméstico en la economía local, y por lo tanto ana
costo podría ser un insumo importante para diseñar política regional. En segundo lugar, este
el de mayor ponderación de gasto en Chile, sobrepasando incluso al de alimentación. Conside
estos argumentos, este artículo propone un método para calcular los diferenciales regionales
en vivienda para las regiones de Chile y sugiere un índice de costo regional de la vivienda.

A continuación se describen algunas consideraciones que se deben tener en cuenta respecto a
características del mercado inmobiliario de las viviendas en particular. En la sección 3 se disc
metodología utilizada. En la sección 4 se mostrarán las estimaciones de las ecuaciones hedon
el punto 5 se estima el índice de precios de vivienda para las regiones de Chile. El punto 6 co
en base a la información discutida en los puntos anteriores.

2. CARACTERÍSTICAS DEL MERCADO INMOBILIARIO

Para estudiar las variaciones en los costos de vivienda se analizan dos conjuntos de caracterí
por un lado aquellas relacionadas al mercado inmobiliario y por otro las que describen las
particularidades físicas de las viviendas.

Con respecto al mercado inmobiliario, las viviendas son productos que requieren un plazo pro
para ingresar al mercado como productos finales, lo que hace que la oferta de viviendas sea
proporcionada principalmente por los *stocks* acumulables, provocando una oferta de vivienda

inelástica (Balchin, 1981).

Con respecto a la demanda por viviendas, en el largo plazo estará afectada positivamente po crecimiento de la población y como este tiene tendencia positiva, se deduce que la demanda incrementará en el tiempo. En resumen, considerando una oferta inelástica y además una de creciente, el equilibrio de mercado de vivienda se ajustará vía precio. Estos ajustes vía precio acentúan aún más cuando se considera que los excedentes de *stock* de vivienda que existen región no pueden ser trasladados a aquellas regiones en donde existen excesos de demanda.

Además de los efectos en el precio producidos por la oferta y demanda, se debe considerar el provocado por la localization. En general, externalidades positivas aumentan la disponibilidad por una vivienda. Así, el consumidor paga por las externalidades positivas[3] que entrega el am vecindad de una vivienda.

Adicionalmente a las características del mercado, se deben considerar algunos atributos prop vivienda para la determinación del su precio. De acuerdo a Witte *et al.* (1979), las viviendas productos heterogéneos, por lo tanto los diferentes precios a los que se transan no reflejan necesariamente diferencias en valoración monetaria, sino que pueden ser atribuidos a diferer sus características. Esta heterogeneidad se vuelve evidente cuando se comparan viviendas en regiones, ya que es más factible que las viviendas encontradas en la encuesta sean muy dife Por ejemplo, una proporción de la población de Santiago tiene ingresos más altos que cualqu región y las viviendas asociadas a esos ingresos tienen características muy distintas y de may que en una región de bajos ingresos. Por lo tanto, para efectuar comparaciones de costo de v entre regiones es necesario corregir la heterogeneidad espacial de ellas.

3. METODOLOGÍA PROPUESTA

La regresión de precios hedónicos ha sido una de las metodologías más utilizadas para compa precios de las viviendas en el espacio. Esta técnica permite descomponer el precio de la vivie valorizando el aporte de cada uno de los atributos respecto al precio total. Los coeficientes es representarán las valoraciones de la demanda por cada uno de los atributos que componen la regresión.

A diferencia de la literatura existente sobre precios hedónicos, este trabajo propone la "comparabilidad" como un elemento necesario para interpretar correctamente los resultados. no homogeneizar las muestras haría de las regresiones hedónicas una estimación inadecuada medida que no permitiría una correcta evaluación de los diferenciales de precios entre las reg En otras palabras, para realizar comparaciones de costos de vivienda entre regiones es neces realizarlas entre viviendas con características similares, minimizando el sesgo producido para heterogeneidad de ellas.

Para obtener la homogeneidad en la comparación de viviendas se utilizará el método llamado *Matching estimator.* Esta técnica permite encontrar para cada vivienda de la región *i* una vivi estadísticamente similar en la Región Metropolitana. De esta manera se obtendrán tantos clo como viviendas existan en la región *i.* Al realizar las regresiones hedónicas sobre estos dos g viviendas se minimizan los efectos provocados por la heterogeneidad espacial.

3.1 *Matching*

La literatura sobre comparaciones de precios en vivienda se encuentra, en su mayoría, circun las regresiones hedónicas. Sin embargo, para esta investigación la metodología propuesta es previamente el *matching estimator.* Este procedimiento consiste en un método estadístico qu compara el efecto promedio provocado por un evento o "tratamiento" sobre un conjunto de observaciones versus un grupo de control, pero considerando que ambos grupos son "compa Su principal campo de aplicabilidad ha sido la evaluación del impacto que generan diversos p sobre grupos de personas. Heckman *et al.* (1997) evalúan a través del *matching* los beneficio monetarios que otorga un programa de capacitación sobre un grupo de trabajadores determi

Luego de realizar una revisión bibliográfica, no se encontraron aplicaciones de esta metodolo estudio de los precios en el mercado inmobiliario, por lo tanto es necesario contextualizar est metodología a los objetivos del estudio.

Para comparar el efecto que "produce" una región sobre el precio de la vivienda sería necesa valorar la vivienda en dos regiones simultáneamente, una de control y la otra para medir el e la región, para luego comparar los precios y verificar si existen diferencias significativas en el Lamentablemente, no es posible contar con la misma vivienda en dos regiones, es decir, no s con la casa afectada por el costo de vida en la región de comparación. Para solucionar este p la metodología propone seleccionar una vivienda con características similares en la región de luego verificar si existen diferencias significativas en sus precios.

Esta metodología considera dos supuestos fundamentales. En primer lugar, se supone que las diferencias en precios de vivienda pueden ser atribuidas en su totalidad a un set *X* de caracte atributos. En segundo lugar, se asume que la distribución probabilística del set *X* es similar ta las viviendas de la región de control[5] como para las viviendas de la región en estudio.

Asumamos que P_0 es el conjunto de precios para las viviendas de la Región Metropolitana (nc tratadas o no afectadas por el evento "región") y que P_1 es el conjunto de precios para las vi de una región determinada. Lo óptimo sería que la vivienda fuese valorada en la región y posteriormente en la Región Metropolitana, pero dado que es imposible, el método encontrar aquellas viviendas de P_0 que posean características similares a la vivienda P_1 de tal manera q viviendas que se están comparando sean estadísticamente similares. Este "pareo" será const sobre un conjunto de *n* características observables.

Lo descrito anteriormente queda especificado a través de la siguiente ecuación.

$$(1) \qquad \Delta = P_1 - \sum_{i=1}^{N} \omega_i \bullet P_0; \quad \forall\ 0 \le \omega_i \le 1; \quad \sum_{i=1}^{N} \omega_i = 1$$

donde el ponderador &ω_i representa la manera en que se construirán aquellas viviendas com de la Región Metropolitana, para cada una de las regiones del país. La teoría recomienda una especificaciones para esta función[6], de las cuales en este trabajo se considerará el método de más cercano. Es decir, para cada una de las viviendas de la región *i* se elegirá la vivienda má parecida de la Región Metropolitana. De esta manera, para cada región se podrá asociar un g viviendas de la Región Metropolitana comparables en precio, ya que poseerán características similares, por lo que ω_i será igual a uno para la vivienda de la Región Metropolitana más pare de Antofagasta por ejemplo y cero para el resto, por lo tanto, se calculará el diferencial de pr entre viviendas "comparables".

Una vez construido este grupo de clones para cada región, se reduce el sesgo que produce el contrastar el precio de viviendas heterogéneas, a través de considerar viviendas comparables permite asumir que las diferencias en precio representan el diferencial en el costo de vida de región respecto a Santiago.

3.2 Regresiones de precios hedónicos

Las regresiones de precios hedónicos se han caracterizado por ser un instrumento econométr usado para medir la relación precio-calidad. Desde el trabajo de Griliches (1971) los avances sustanciales, marcando un paso significativo el trabajo de Muellbauer (1974), el cual contextu regresiones hedónicas en la teoría de elección del consumidor. La regresión hedónica puede s representada por la siguiente expresión:

$$(2) \qquad Ln\,P_{ij} = \sum_{w} \alpha_k Q_{\tilde{a}ij} + \varepsilon$$

donde *i* es una observación en cada una de las regiones *j* y *k* es una dimensión de calidad[7]. E herramienta trabaja sobre una serie de supuestos necesarios para su aplicabilidad e interpret En primer lugar se asume que existen los mercados para cada uno de los atributos que comp una vivienda, es decir, es posible conocer el precio de cada una de sus características. En seg lugar se mantiene el supuesto de atomicidad, es decir, ningún agente del mercado tiene el po suficiente para influir en el precio de los bienes, por lo tanto el consumidor es un precio acep toma los precios como dados (Muellbauer, 1974). En tercer lugar, si bien se considera la vivie como un producto multiatributo, se especifica que no existe diferencia alguna entre las calida las características de las viviendas. Es decir, no existen diferencias entre la pared de adobe d vivienda en Antofagasta y una pared de adobe para su similar en la Región Metropolitana (La 1966).

A través de las regresiones hedónicas es posible estimar los precios implícitos, o #945; de ac la ecuación 2, de las características de las viviendas tanto para la región *i* como para sus clon Región Metropolitana. Con la información de precios y cantidades, es posible construir un índi permita estimar la diferencia promedio del costo de vivienda entre una región y la Región Metropolitana. En este contexto, la teoría recomienda diversas medidas de agregación, siend reconocidas los índices de Laspeyres, Paasche y Fisher.

Para los objetivos de este artículo no sólo es relevante la comparación entre las viviendas de región y sus clones, sino también la comparación directa entre regiones. De acuerdo a esto e de Fisher permite calcular de manera directa el diferencial entre dos regiones ya que cumple axioma de transitividad (Diewert, 1976). Esto se puede realizar a través de la siguiente especificación:

$$(3) \qquad IF_{ij} = IF_{iS} \,/\, IF_{jS}$$

Es decir, la diferencia de precios de vivienda entre las regiones *i yj* puede

ser obtenida mediante la división de sus índices de Fisher respecto a Santiago *(IF_{iS}* y *IF_{jS}* respectivamente). De esta manera, para comparar entre regiones no es necesario encontrar clones respectivos, sino solamente comparar sus índices.

Por otra parte el índice de Fisher puede ser estimado a partir de la siguiente especificación:

$$(4) \qquad \ln I_F = 0{,}5\left(\ln\left(P_S\right) - \sum \alpha_{k,i} X_{k,S}\right) + 0{,}5\left(\sum \alpha_{k,S} X_{k,i} - \ln\left(P_i\right)\right)$$

donde a_k son los parámetros a estimar con el modelo hedónico y X_k son matrices con los valo promedios de las variables utilizadas para cada región. El primer componente es el índice de de Paasche usando como base la canasta de atributos de la Región Metropolitana, mientras q segundo corresponde al índice de Precio de Laspeyres usando como base de comparación la c de atributos de la Región *i,* ambos índices multiplicados por 0,5.

3.3 Bases de datos

Los datos fueron obtenidos de la Encuesta de Caracterización Socioeconómica de Chile (CASE Las medias de las variables se encuentran en el Cuadro 1. La primera fila contiene los promec las variables para las regiones, la segunda fila corresponde al promedio de las viviendas de la Metropolitana utilizadas como clones de las viviendas de cada región y la tercera fila muestra promedio para todas las observaciones de la Región Metropolitana, es decir, sin considerar lo

Se aprecia que en general las medias de los clones son más similares a las regiones que las r de la muestra total de Santiago. Las medias de Santiago son en su mayoría superiores a las regiones. Este es un indicio de que la hipótesis planteada respecto a la heterogeneidad de la comparación regional podría no ser totalmente controlada por la regresión hedónica debido a distintos rangos de las variables en las diferentes regiones. En las últimas dos filas el Cuadro muestra el tamaño muestral para cada región y el tamaño muestral expandido utilizando los ponderadores regionales de la encuesta CASEN, lo que indica una representatividad de una c relevante de viviendas del país. Como variable dependiente se utilizó el logaritmo natural de respuesta a la pregunta ¿Cuánto paga de arriendo?[8]. Las variables independientes descritas e Cuadro 1 pueden ser divididas en dos grupos. En el primero se agrupan variables como Baño Cocinas, Piezas, Teléfono Fijo, TV Cable y Calefón que describen las características físicas de vivienda.

CUADRO 1
VALORES PROMEDIO DE LAS CARACTERISTICAS DE LAS VIVIENDAS Y PRECIOS DE ARRIENDO

Variables/Regiones		Origen	I	II	III	IV	V	VI	VII	VIII	IX	X	XI
Variable Dependiente	Log(arriendo)	Región	11,17	11,40	10,87	10,99	11,19	10,81	10,75	10,95	10,93	11,04	11,1
		Clones	11,29	11,07	11,24	11,04	11,20	11,15	10,95	11,20	11,09	11,17	11,0
		Santiago	11,49	11,49	11,49	11,49	11,49	11,49	11,49	11,49	11,49	11,49	11,4
Características Físicas	Baños	Región	1,15	1,11	1,03	1,12	1,14	0,97	1,02	1,08	1,16	0,98	0,9
		Clones	1,11	1,06	0,96	1,02	1,10	0,95	0,92	1,12	1,09	1,04	0,9
		Santiago	1,28	1,28	1,28	1,28	1,28	1,28	1,28	1,28	1,28	1,28	1,2
	Cocinas	Región	0,79	0,82	0,71	0,79	0,94	0,86	0,79	0,78	0,73	0,70	0,5
		Clones	0,80	0,77	0,73	0,78	0,88	0,79	0,77	0,79	0,69	0,72	0,6
		Santiago	0,91	0,91	0,91	0,91	0,91	0,91	0,91	0,91	0,91	0,91	0,9
	Piezas	Región	3,72	3,86	3,64	3,77	3,70	3,48	3,87	3,58	3,75	3,72	3,4
		Clones	3,33	3,41	3,12	3,24	3,50	3,25	3,17	3,41	3,20	3,31	3,0
		Santiago	3,61	3,61	3,61	3,61	3,61	3,61	3,61	3,61	3,61	3,61	3,6
	Teléfono	Región	0,36	0,43	0,15	0,26	0,42	0,27	0,26	0,32	0,24	0,23	0,3
		Clones	0,34	0,33	0,14	0,32	0,35	0,26	0,20	0,33	0,17	0,27	0,2
		Santiago	0,58	0,58	0,58	0,58	0,58	0,58	0,58	0,58	0,58	0,58	0,5
	TV Cable	Región	0,40	0,38	0,11	0,10	0,37	0,23	0,16	0,26	0,14	0,27	0,2
		Clones	0,41	0,20	0,09	0,10	0,29	0,27	0,13	0,29	0,20	0,26	0,2
		Santiago	0,27	0,27	0,27	0,27	0,27	0,27	0,27	0,27	0,27	0,27	0,2
	Calefont	Región	0,37	0,51	0,57	0,63	0,78	0,69	0,59	0,50	0,54	0,49	0,5
		Clones	0,37	0,60	0,57	0,63	0,73	0,66	0,57	0,54	0,49	0,49	0,4
		Santiago	0,83	0,83	0,83	0,83	0,83	0,83	0,83	0,83	0,83	0,83	0,8
Calidad y Entorno	Quinto Quintil	Región	0,27	0,27	0,27	0,31	0,26	0,29	0,32	0,32	0,31	0,29	0,2
		Clones	0,25	0,29	0,25	0,29	0,26	0,25	0,23	0,28	0,25	0,32	0,3
		Santiago	0,30	0,30	0,30	0,30	0,30	0,30	0,30	0,30	0,30	0,30	0,3
	Calidad	Región	0,94	0,88	0,90	0,89	0,87	0,87	0,77	0,82	0,81	0,84	0,8
		Clones	0,93	0,85	0,89	0,86	0,86	0,87	0,82	0,87	0,85	0,86	0,8
		Santiago	0,93	0,93	0,93	0,93	0,93	0,93	0,93	0,93	0,93	0,93	0,9
Muestra			249	248	192	303	888	358	530	1087	525	710	11
Muestra expandida			17.098	20.249	8.501	22.010	75.559	33.511	27.861	69.175	27.516	33.687	3.56

Fuente: Elaboración propia en base a CASEN 2003.
Notas: La muestra para la Región Metropolitana, Santiago, son 2.190 y su muestra expandida fueron 324.498. Región: promedio de la variable para las reg promedio para las viviendas clones en la RM. Santiago: promedio para todas las observaciones de RM.

El segundo grupo captura calidad y entorno de la vivienda. La variable Quintil de Ingreso Aut Per Capita Regional es utilizada como un *proxy* de la calidad del entorno en el que se encuent vivienda. Esta es una variable binaria que tiene un valor igual a uno si un hogar pertenece al quintil, el de más altos ingresos, y cero en otro caso. Esto asume que existe una mayor prob de que la vivienda esté rodeada de hogares con altos ingresos y en un entorno con mayores mejores amenidades. Por lo tanto, el coeficiente asociado a esta variable refleja la valoración entorno a la vivienda. Adicionalmente, se incluye una variable que mide la calidad de la vivie (índice de Calidad). Esta variable captura la calidad de una vivienda que se ha estimado com función de un conjunto de variables explicatorias disponibles en la CASEN 2003, tales como: de las paredes, cubierta del techo, piso, etc.

Las regresiones hedónicas se caracterizan por presentar problemas de mul-ticolinealidad. Por previo a la estimación, las variables explicativas fueron analizadas y tratadas para reducir las potenciales distorsiones provocadas por la alta correlación entre ellas. Para minimizar la ines que puede generar en la estimación de los coeficientes se realizó un análisis factorial y utiliza método de *variable suplente* de Hair *et al.* (1998), se seleccionaron las variables explicativas por la menor colinealidad entre ellas y que contengan la mayor información sobre las caracte

de la vivienda. Finalmente, se calcularon el *Factor de Inflación de Varianza* y el *índice de Con* indicando ambos que los efectos de la multicolinealidad entre las variables independientes no significativos en la estabilidad de los parámetros.

4. ESTIMACIÓN DE LAS ECUACIONES DE PRECIOS HEDÓNICOS

El Cuadro 2 presenta los coeficientes estimados de la ecuación de precios hedónicos utilizand muestras totales para las trece regiones, mientras que el Cuadro 3 muestra la estimación asc cada región utilizando los clones obtenidos de la Región Metropolitana. En general, las estima presentan los signos esperados y una estabilidad adecuada. Sin embargo, no todos los coefic tienen el signo esperado; al respecto Bover y Velilla (2001) sostienen que "se suele argumen las estimaciones hedónicas de los precios sombra de las características son inestables y que siempre tienen sentido económico. Sin embargo, estimaciones imprecisas de los coeficientes pendiente individuales no invalidan necesariamente la inflación estimada corregida por calida deriva de estas estimaciones. En segundo lugar, las características no observadas omitidas correlacionadas con las características incluidas podrían sesgar gravemente las estimaciones hedónicas. Esto podría ser más problemático para determinados productos como la vivienda, importancia, por ejemplo, de la calidad de la construcción o de la ubicación precisa, que son normalmente características no observadas".

CUADRO 2
RESULTADOS ECONOMETRICOS PARA REGIONES Y SANTIAGO

	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Baño	0,44*	0,19*	0,03	0,34*	0,33*	0,34*	0,32*	0,27*	0,39*	0,25*	0,36*	–0,44*
Cocina	0,06*	0,33*	–0,01	0,15*	0,27*	0,14*	0,01	0,07*	0,25*	0,18*	0,20*	–0,11*
Piezas	0,11*	0,14*	0,09*	0,09*	0,08*	0,16*	0,08*	0,07*	0,15*	0,06*	0,13*	0,19*
Teléfono(1)	–0,00	0,13*	0,08*	0,20*	0,12*	0,06*	0,32*	0,17*	0,19*	0,07*	0,15*	0,02
TV Cable(1)	0,08*	0,04*	–0,15*	0,21*	–0,02*	0,09*	0,15*	0,03*	0,07*	0,13*	–0,01	–0,18*
Calefont(1)	0,37*	0,17*	0,48*	0,34*	0,33*	0,14*	0,29*	0,30*	0,21*	0,34*	0,29*	0,22*
Calidad	0,05*	0,24*	0,13*	0,28*	0,24*	0,31*	0,26*	0,30*	0,24*	0,18*	0,07*	0,24*
Quinto Quintil(2)	1,14*	0,49*	0,64*	1,09*	0,91*	0,99*	0,78*	1,32*	0,84*	0,73*	0,68*	4,41*
Constante	8,95*	9,70*	9,64*	8,83*	9,11*	8,73*	9,13*	8,97*	8,81*	9,55*	9,39*	6,62*
R2	0,53	0,68	0,34	0,68	0,49	0,66	0,63	0,53	0,70	0,58	0,66	0,36

Fuente: Elaboración propia en base a CASEN 2003.
Notas:
* Coeficientes significativos al 99%.
(1) Variables dicotómicas que toman valor cero si la vivienda no tiene el atributo y uno si lo tiene.
(2) Variables dicotómicas que toman valor uno si pertenece al quinto quintil y cero si no pertenece.

En este sentido, los Cuadros 2 y 3 muestran que la variable calidad es muy estable y en todo casos presenta el signo esperado. A la vez, el *proxy* del entorno o localization (quintil 5) tiene esperado exceptuando los clones de la Región de Magallanes. Por lo que se asume que los sig negativos no invalidan los resultados obtenidos, basados en la consistencia de los resultados los coeficientes con signos diferentes a los esperados son de alrededor de un 5 por ciento del coeficientes estimados.

CUADRO 3
RESULTADOS ECONOMETRICOS PARA REGIONES Y SUS CLONES EN SANTIAGO

		I	II	III	IV	V	VI	VII	VIII	IX	X	XI
REGIONES	Baño	0,44*	0,19*	0,03	0,34*	0,33*	0,34*	0,32*	0,27*	0,39*	0,25*	0,36*
	Cocina	0,06*	0,33*	-0,01	0,15*	0,27*	0,14*	0,01	0,07*	0,25*	0,18*	0,20*
	Piezas	0,11*	0,14*	0,09*	0,09*	0,08*	0,16*	0,08*	0,07*	0,15*	0,06*	0,13*
	Teléfono(1)	-0,00	0,13*	0,08*	0,20*	0,12*	0,06*	0,32*	0,17*	0,19*	0,07*	0,15*
	TV Cable(1)	0,08*	0,04*	-0,15*	0,21*	-0,02*	0,09*	0,15*	0,03*	0,07*	0,13*	-0,01
	Calefont(1)	0,37*	0,17*	0,48*	0,34*	0,33*	0,14*	0,29*	0,30*	0,21*	0,34*	0,29*
	Quinto Quintil (2)	0,05*	0,24*	0,13*	0,28*	0,24*	0,31*	0,26*	0,30*	0,24*	0,18*	0,07*
	Calidad	1,14*	0,49*	0,64*	1,09*	0,91*	0,99*	0,78*	1,32*	0,84*	0,73*	0,68*
	Constante	8,95*	9,70*	9,64*	8,83*	9,11*	8,73*	9,13*	8,97*	8,81*	9,55*	9,39*
	R^2	0,53	0,68	0,34	0,68	0,49	0,66	0,63	0,53	0,70	0,58	0,66
CLONES	Baño	0,34*	0,40*	0,31*	0,74*	0,59*	0,28*	0,65*	0,39*	0,35*	0,38*	0,24*
	Cocina	0,20*	0,37*	-0,01	-0,51*	-0,29*	0,17*	-0,21*	0,06*	0,22*	0,07*	0,14*
	Piezas	0,06*	0,12*	0,06*	-0,01	-0,08*	0,07*	-0,05*	0,04*	-0,01*	0,05*	0,05*
	Teléfono(1)	0,06*	0,21*	0,18*	-0,50*	0,12*	0,19*	-0,06*	0,24*	0,16*	0,16*	0,31*
	TV Cable(1)	0,22*	0,17*	0,16*	0,26*	0,02*	0,07*	0,07*	0,10*	0,14*	0,18*	0,08*
	Calefont(1)	0,13*	-0,12*	0,26*	0,22*	0,13*	0,33*	0,15*	0,22*	0,25*	0,22*	0,39*
	Quinto Quintil(2)	0,59*	0,23*	0,33*	0,58*	0,35*	0,38*	0,35*	0,33*	0,27*	0,27*	0,28*
	Calidad	1,56*	1,95*	1,12*	2,96*	2,20*	0,87*	2,62*	1,12*	1,32*	1,11*	1,11*
	Constante	8,78*	8,19*	9,50*	7,98*	8,95*	9,40*	8,38*	9,29*	9,23*	9,31*	9,32*
	R^2	0,65	0,69	0,59	0,39	0,44	0,61	0,38	0,60	0,61	0,59	0,65

Fuente: Elaboración propia en base a CASEN 2003.
Notas:
* Coeficientes significativos al 99%.
(1) Variables dicotómicas que toman valor cero si la vivienda no tiene el atributo y uno si lo tiene.
(2) Variables dicotómicas que toman valor uno si pertenece al quinto quintil y cero si no pertenece.

Tal como se puede apreciar en los Cuadros 2 y 3, la mayoría de los coeficientes son significat 99 por ciento de confianza. Por otra parte, el ajuste de las regresiones es alto para casi todas regiones, exceptuando la Duodécima Región y sus clones como también para la Región de At La baja calidad del ajuste de los datos se debe principalmente a la menor cantidad de observ consideradas en dichas regiones.

5. ÍNDICE DE COSTO DE VIVIENDAS PARA LAS REGIONES DE CHILE

Utilizando los tres cuadros previos se construyó el Cuadro 4 que contiene tres índices de cost vivienda para las regiones de Chile. La primera columna muestra un índice simple construido de los promedios ponderados de las observaciones obtenidas para cada una de las regiones. hay control ni de las características de las viviendas utilizadas en el cálculo, como tampoco de heterogeneidad regional de ellas. Este índice muestra que la Región Metropolitana sería la reg cara de Chile, mientras que la Región del Maule sería la de menor costo de vivienda. Sin emb cuando se controla por las características de las viviendas, la calidad de su construcción y el donde están ubicadas se obtiene el resultado de la segunda columna (Hedónico) del Cuadro 4 demostrando una estructura de costos diferente y además mayores diferencias entre las regi índice de Fisher, calculado según la ecuación 4 muestra, por ejemplo, que la región más cara Antofagasta- tiene 40 puntos de diferencia con la más barata (Sexta Región). Es notable que diferencia es solamente de 7 puntos porcentuales si no se realiza ninguna corrección. Todas l regiones se comparan a la Región Metropolitana y dadas las propiedades del índice de Fisher, puede realizar una comparación directa entre regiones.

Sin embargo, aun cuando el método de las ecuaciones de precios hedóni-cos permite control diferencias en las distintas variables consideradas, asume que las muestras son homogéneas, decir, asume que en la muestra existe una distribución de viviendas de similares característic calidad y ubicación para todas las regiones. Este supuesto no se cumple, tal como se puede a en el Cuadro 1. Esto es más evidente cuando se observan las distribuciones de las variables p diferentes regiones. Es por ello que en este trabajo se postula que previo a la estimación de l ecuaciones de precios hedónicos es necesario homogeneizar las muestras de modo que se co

sólo aquellas viviendas que tienen similares características y no todas las viviendas. En caso
se estarán comparando costos de bienes distintos, lo cual no tiene sentido cuando se está
comparando costo de vida entre las regiones.

La tercera columna del Cuadro 4 (Hedónicos/Maíc/ang) reporta el índice con muestras
homogeneizadas a través del método de pareo *(matching)* donde se utilizó la Región Metropc
como la proveedora de los clones debido a que tenía el mayor número de observaciones. Con
observa aquí las diferencias son mayores; la Región de Antofagasta se mantiene como la más
mostrando un costo de vivienda 18 por ciento más alto que la Región Metropolitana.

CUADRO 4
COMPARACION DE INDICES

Regiones/Indices	Promedio	Hedónicos	Hedónicos/Matching
I	97,2	87,1	83,3
II	99,2	107,6	118,1
III	94,6	66,9	64,5
IV	95,7	77,6	83,0
V	97,4	84,4	93,7
VI	94,1	65,2	66,9
VII	93,5	69,3	79,6
VIII	95,2	81,0	82,8
IX	95,1	78,1	79,8
X	96,1	89,3	90,5
XI	96,8	100,2	96,7
XII	99,1	73,9	94,4
RM	100,0	100,0	100,0

Fuente: Elaboración propia en base a CASEN 2003.

6. CONCLUSIONES

La construcción de un índice regional de costo de vivienda fue el objetivo de este trabajo. En
desarrollo se demuestra la importancia que tiene el controlar por las características de la vivi
calidad y entorno. En este sentido, la construcción de un índice superlativo como el de Fisher
permite la com-parabilidad entre regiones basado en ecuaciones hedónicas, es aconsejable.

Este trabajo agrega un elemento adicional a esta recomendación de la literatura tradicional y
necesidad de homogeneizar las muestras antes de aplicar regresiones hedónicas. Una aplicac
regiones chilenas señala los sesgos que surgen cuando la heterogeneidad de las muestras reg
es ignorada.

Uno de los resultados más relevante es la diferencia que surge de este procedimiento entre la
Metropolitana y la Región de Antofagasta (II). Cuando se compara el promedio ponderado, ap
Región Metropolitana levemente más cara que la Región de Antofagasta, sin embargo cuando
estima el índice a través de la regresión hedónica esta diferencia se invierte y resulta la Regic
Antofagasta 7,6 por ciento más cara. La regresión de precios hedónicos produce un primer pr
homogeneización de viviendas al controlar por características. Sin embargo, cuando se homo
las muestran, esta diferencia crece más del doble.

Un indicio para este resultado proviene de otra investigación en progreso, donde se muestra
diferencia del ingreso promedio ponderado de la ocupación principal obtenido a partir de la m
encuesta CASEN 2003 para la Región Metropolitana es más de 20 por ciento superior al de la
de Antofagasta. Si se considera el ingreso proveniente de la propiedad del capital, esta difere
aún superior debido a la mayor proporción de dueños de capital que viven en la Región Metrc
respecto a Antofagasta. Si consideramos que la vivienda es un bien normal o superior o mira

canastas de consumo obtenidas en la Encuesta de Presupuesto Familiar para Santiago e Iquic 1996, podremos apreciar que la proporción de gasto en vivienda es levemente superior para y está alrededor de 23 por ciento del ingreso. Esto implica, a igual costo de vivienda, que exis grupo de viviendas en la Región Metropolitana que no está disponible en la Región de Antofag por lo tanto no deberían ser consideradas a la hora de comparar costos de vivienda entre am regiones.

El proceso de pareo *(matching)* elimina ese grupo de viviendas de la muestra y compara sólo comparables u homogéneas, eliminando el sesgo producido por esa heterogeneidad y entrega mejor aproximación del diferencial de costo de vivienda entre regiones.

NOTAS

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[1]La estructura axiomática de los índices de precios exige que entre sus propiedades se encue comparación de unidades espaciales de igual base. Es decir, si se tiene el diferencial de preci la Región de Antofagasta y Región Metropolitana, a la vez que se cuenta con el de la Región d Magallanes y Región Metropolitana es posible obtener el diferencial de la Región de Antofagas Región de Magallanes dividiendo sus índices.

[2]Este gasto puede ser considerado como la actualización de los pagos que puede efectuar un individuo en vivienda a lo largo de su vida. En este sentido, vale la pena destacar que los pre vivienda considerados para este estudio se refieren única y exclusivamente a precios de arrie

[3]Es importante apuntar que el individuo no paga por la localización geográfica específica de u vivienda, sino más bien por el entorno en el que ubica esta, considerando elementos como se áreas verdes, calidad de los vecinos, etc.

[4]En esta línea, más referencias a la metodología se encuentran en Heckman (1998).

[5]Para este estudio, se asume que las viviendas de control pertenecerán a la Región Metropoli Existen dos razones para esta elección, en primer lugar la Región Metropolitana es la más desarrollada del país, por lo tanto es razonable hacer comparaciones respecto a ella. En segu lugar, la Región Metropolitana tiene la mayor cantidad de viviendas, por lo que es más factibl encontrar en ella clones para cada región

[6]El ejemplo más común es tomar simplemente el promedio geométrico del arriendo de todas viviendas de Santiago y compararlo con su similar de las viviendas de Antofagasta.

[7]También pueden ser variables que indiquen cantidad de atributos o Idealización de la vivienc

[8]En esta pregunta el individuo revela el valor pagado por arriendo o una estimación de éste s propietario. Para el estudio realizado se utilizó solo lo reportado por los arrendatarios, ya que un precio de mercado y no una valoración subjetiva como lo es la otra respuesta.

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