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Information and Price Determination Under Mass Privatization

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Information revealed through the bidding process was the most important factor determining the price at which shares were sold under the mass privatization program in the Czech and Slovak Republics.

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Summary findings

The valuation of enterprises has been a major stumbling block to privatization in transitional economies. Data on the performance of state-owned enterprises under central planning is plentiful, but that information is not worth much in a market economy, especially one in which much progress has been made in price and trade liberalization.

Voucher privatization schemes have emerged as a politically attractive alternative; the valuation problem is overcome through a decentralized system of bidding, while shares are efficiently allocated through an auction. But nobody has analyzed how these information markets function or how prices emerge from bidding rounds.

Shafik presents econometric evidence on the functioning of information markets and on the process by which prices emerged for enterprise shares under the Czech and Slovak mass privatization scheme. The results indicate that public information about enterprises' past performance clearly mattered, especially in the early

rounds when private information had not been revealed. But such historical information alone never explained more than 29 percent of the variation in the ultimate equilibrium price.

Instead, information about enterprises' prospects revealed through the bidding process explained about 85 percent of the variation in prices by the final rounds. Private or "insider" information about enterprises' prospects played a gradually diminishing role as participants learned quickly from each other's bidding behavior.

Other mass privatization schemes rely more heavily on the secondary market to generate an appropriate valuation of shares, rather than on the initial valuations emerging from the primary market. But if improved information is the first step toward efficient asset markets and corporate governance, participants in the Czech and Slovak mass privatization scheme have a head start on other transitional economies.

This paper — a product of the Country Operations Division, Europe and Central Asia, Country Department II — is part of a larger effort in the department to analyze innovative approaches to privatization in transition economies. Copies of the paper are available free from the World Bank, 1818 H Street NW, Washington, DC 20433. Please contact Azeb Yideru, room H7-051, extension 36067 (23 pages). June 1994.

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Introduction

Valuation of enterprises has been a major stumblingblock to privatization in transition economies. Although data about performance of state-owned enterprises under central planning is plentiful, the value of that information is minimal in the context of a market economy, especially where substantial progress has been made in price and trade liberalization. Voucher privatization schemes have emerged as a politically attractive alternative that overcome the valuation problem through a decentralized system of bidding while generating an efficient allocation of shares through an auction. However, the functioning of these information markets and the process by which prices emerge from these bidding rounds has not been analyzed.

The Czech and Slovak Republics provide perhaps the best case for analyzing price determination under voucher privatization. In addition to being the first to attempt mass privatization, the Czechs and Slovaks designed a scheme that was unique in its capacity to generate and use information about market values. This paper focuses on how information was used to create a market for enterprise shares; a detailed description of the scheme is available elsewhere.¹ The section that follows provides a brief description of the way in which the voucher scheme in the Czech and Slovak Republics addressed the information problem associated with valuation and compares that to other mass privatization schemes in transition economies. Thereafter, econometric evidence on the determinants of the equilibrium price level and dynamics for enterprise shares are presented. The final section draws some lessons about the design of the scheme and the role of information in creating a market value for enterprise shares.

^{1/} Shafik, N. (1993), "Making a Market: Mass Privatization in the Czech and Slovak Republics," Policy Research Working Paper number 1231, The World Bank.

Alternative Approaches

There is not a great deal of theoretical literature that can guide the analysis of schemes such as mass privatization. Conventional auction theory, while somewhat relevant, is based on situations where the demand curve, often for a homogeneous product, is unknown and the auctioneer is concerned with revealing the demand curve to maximize revenue. The focus of much of the literature has been on the trade-offs associated with open versus sealed bid procedures, uniform versus discriminatory price rules, sequential versus simultaneous auctions, and the risk of collusive behavior under different schemes.² In a very interesting study of the determinants of privatization prices for enterprises auctioned by the Mexican Government, Lopez-de-Silanes analyzes the impact of company performance and industry parameters, the auction process, and the prior restructuring actions taken by the state on net government revenues from privatization.³ He finds that higher sales prices tend to be associated with the speed of the process, labor shedding, firing of the chief executive officer of the enterprise and deinvestment, while negative premiums result from large obligations to the labor force and minority control packages. Prior restructuring by the government, debt absorption, new investment or performance improvement programs have no beneficial impact on ultimate government revenues from privatization auctions. In the case of mass privatization considered here, the nature of the auction is rather special. The aggregate demand (coupons) and supply (shares)

^{2/} For surveys of this literature, see J.L. Guasch and T. Glaessner (1993), "Using Auctions to Allocate and Price Long-Term Credit," The World Bank Research Observer, volume 8, number 2, July. R. Feldman and R. Mehra (1993), "Auctions: Theory and Possible Applications to Economies in Transition," IMF Working paper 93/12, February. Feinstein, J. and M. Block (1985), "Asymmetric Information and Collusive Behavior in Auction Markets," American Economic Review, volume 75, June. R. Hansen (1985), "Empirical Testing of Auction Theory," American Economic Review, volume 75, May. E. Maskin and J. Riley (1985), "Auction Theory with Private Values," American Economic Review, volume 75, May.

^{3/} López-de-Silanes, Florencio (1994), "Determinants of Privatization Prices," mimeograph, Harvard University, Cambridge, MA, January.

to be auctioned is fixed, but the true relative values of the non-uniform products to be auctioned is unknown to both the auctioneer and to most bidders.

The vast literature on stock price determination in advanced market economies is also relevant, but much of it has focused on tests of the efficient market hypothesis in an effort to evaluate whether financial markets rationally value assets and prevent the generation of excess profits.⁴ The two most widely used theories – the Capital Asset Pricing Model (CAPM) and the Arbitrage Pricing Theory (APT) focus on the importance of systematic, non-diversifiable factors for explaining changes in asset prices. This literature focuses on incremental movements from one equilibrium for asset prices to another and assumes vast amounts of past information, well functioning markets, and a reasonably stable external environment enabling forward-looking behavior. While this work is particularly relevant for analysis of secondary market behavior, it does not provide much guidance for the initial valuation of enterprise shares in a transition economy with limited markets and experiencing a fundamental change in economy-wide prices.

More recently, Boycko, Shleifer and Vishny (1993) have considered the issue of auction design in the context of mass privatization.⁵ They argue that the most obvious auction design would require each bidder to submit the number of shares desired and the maximum price s/he is willing to pay. However, such an auction would be overly complex and inaccessible to small investors. An alternative is to allow each investor to bid all their vouchers for one enterprise,

4/ For examples, see Fama, E. and K. French (1992), "The Cross-Section of Expected Stock Returns", Journal of Finance, volume 48, number 2; Fama, E. (1991), "Efficient Markets : II" Journal of Finance, volume 46; Fama, E. and K. French (1988), "Dividend Yields and Expected Stock Returns" Journal of Financial Economics, volume 22, number 1; Poterba, J. and L. Summers (1988), "Mean Reversion in Stock Prices : Evidence and Implications," Journal of Financial Economics, volume 22, number 1; Poterba, J. and L. Summers (1986), "The Persistence of Volatility and Stock Market Returns," American Economic Review, volume 76.

5/ M. Boycko, A. Shleifer, R. Vishny (1993), "Voucher Privatization," mimeograph, September. For an interesting analysis of the factors influencing the design of the Russian privatization program, see M. Boycko, A. Shleifer and R. Vishny (1993), "Privatizing Russia," mimeograph, August.

effectively assuming that the demand curve for shares is unit elastic such that investors want to spend a fixed amount on a chosen stock. While such an auction design achieves simplicity and equity objectives, superior information of some market participants cannot substantially influence final prices. Thus they recommend a combined scheme whereby uninformed investors make simple bids of all their vouchers for one company while more sophisticated investors are permitted to specify the quantity and the maximum price for shares. Although this auction design was used in Russia, less than 2% of the bidders chose to submit the more complicated bids, possibly reflecting the paucity of information about enterprise values.

Mass privatization schemes have become very widespread in formerly centrally planned economies, with examples in Russia, Ukraine, Latvia, Lithuania, Georgia, Mongolia, Poland and the Czech and Slovak Republics. The Czech and Slovak scheme was the first such scheme and only Russia and Lithuania have also advanced in implementing mass privatization. Since descriptions of the different approaches are available elsewhere,⁶ the focus here will be on the role of information under different schemes to highlight the differences with the Czech and Slovak approach.

The role of information under other mass privatization schemes depends very much on the design of the programs, which are largely the outcome of the political process. In more decentralized approaches, like that taken in the Czech and Slovak Republics described below, public information and market forces play a crucial role in the valuation and allocation of shares. In more centralized approaches, such as in Poland, public information is less important since the design of the program is intended to reduce the need for active public involvement by relying on investment funds to be informed, to be diversified to protect to citizens who own shares in the funds, and to exercise

^{6/} For descriptions of the differences among these schemes, see I. Lieberman, M. Mejstik, J. Burger, and S. Rahuja (1994), "Mass Privatization in Central and Eastern Europe and the Former Soviet Union: A Comparative Analysis," mimeograph, Washington, D.C.: The World Bank.

governance.⁷ Where insiders (workers and managers) are major players in mass schemes (such as in Russia and, to a lesser extent, in Lithuania), usually because of the political constraints to implementing privatization, the information problem may be smaller, although the efficiency gains for share markets that result from the public good character of information are not realized⁸.

Information and Mass Privatization in the Czech and Slovak Republics

The mass privatization scheme was based on the principle that citizens should receive equal claims on enterprise shares to be privatized. Each citizen was given 1000 points for bidding purposes for a nominal fee of Kcs. 1000 (equivalent to \$35 or one week of the average wage). The assets to which these claims would be attached would be determined through a simultaneous bidding process. The size of the transfer to citizens was purely a function of the number of people who chose to participate in the scheme. With 8.5 million participants, each Czech and Slovak citizen was transferred claims on the equivalent of Kcs. 35,300 in book value terms on average (equivalent to about \$1250, or about one-half of annual per capita income).

^{7/} The Polish program, which remains to be implemented, relies heavily on large investment funds that hold strategic allocations of shares (33%) in enterprises. Citizens get shares in funds, who then select the enterprises that will be in their portfolio based on a "football pool." Individuals are assigned funds in which they will place their vouchers, but individuals are not given the opportunity to hold shares directly in enterprises. Thus the Polish approach is more centralized and protects citizens from potential initial losses likely in certain enterprises by forcing diversification on funds.

^{8/} The Russian and Lithuanian schemes are based on decentralized bidding whereby enterprises are auctioned sequentially, not simultaneously. In Lithuania, vouchers had face values based on citizen's ages and were not initially tradable. Bidders could use a combination of vouchers and/or cash to bid for shares in either small or large enterprises or to pay housing loans. While information about enterprises was published, there was substantial insider knowledge, especially since Lithuania is a fairly small country. In Russia, bidders specify the number of vouchers they want to invest in an enterprise. This can either be an open bid whereby the number of shares they receive depends on the number of competing vouchers submitted, or the bid can be limited by either a maximum price or a minimum number of shares that are acceptable per voucher bid. The privatization agency establishes a floor price, below which bids are discarded. The final share price is calculated by taking a weighted average of the number of bids at the floor price and those specified bids that fell above the floor price.

"Equilibrium" prices would emerge as a result of sequential bidding rounds after which prices would be adjusted to reconcile supply and demand. The equilibrium did not represent a global equilibrium because foreigners were not permitted to obtain vouchers directly, nor were vouchers tradable (unlike in Russia) prior to completion of the rounds and formal issuance of shares to participants. In effect, the government created an artificial primary market where participation was restricted to nationals who were given purchasing power by the state in the form of vouchers. This is why the price level that emerged from the bidding process, defined in money term or in points per share, was completely irrelevant because the scheme was intended to be a pure transfer of assets and the Kcs 1000 fee was intended to cover only the administrative costs of running the scheme. What was relevant were the relative prices that the bidding process generated for shares in different enterprises and the price level that emerges in the secondary market for shares in which there is full tradability.

Prior to initiation of the bidding rounds, there was a "zero round" in which citizens had the opportunity to hand over their vouchers (or some portion thereof) for management by any one of the 429 investment funds (which functioned like mutual funds) that had emerged to participate in the voucher scheme. In effect, the zero round gave bidders a chance to self-select into groups of informed and uninformed buyers. Because uninformed buyers were more likely to give their points to an investment fund, the zero round increased the proportion of information relative to "noise" that would emerge from the market.

At the start of the bidding process there were two types of information available to bidders: (1) public information on enterprise characteristics that were published in the newspaper, and (2) private information that individuals and funds had about enterprise prospects. This private information had the greatest value in the first bidding round when all enterprise shares were offered for the same price. Thereafter, bidders revealed their private information through their bids, which

was reflected in the prices that emerged after each round. This third type of information on relative prices for enterprise shares was revealed over time in the course of the bidding rounds.

Although the government issued warnings about the quality and relevance of data on enterprises' past performance, a considerable quantity of data was provided to the public prior to privatization. The Center for Coupon Privatization published a list of 1491 companies with a book value of Kcs. 300 billion (about \$10.6 billion) on May 13, 1992 which would be included in the coupon scheme. This publication, which was widely available at newsstands and post offices around the country, included the following information for each enterprise: name, address, business activity, identification number, shares offered, book value, value of other enterprise assets, debts, output in 1989-91, book profit in 1989-91, number of employees in 1989-91, allocation of non-coupon shares (prior commitments of shares to foreign investors, domestic investors, restitution claims, the state or the National Property Fund, or sale of shares through some third party such as a bank). Since price and trade liberalization had started in the summer of 1990 and the trading arrangements under the Council for Mutual Economic Assistance collapsed in January 1990, the data on enterprise performance in 1990 and 1991 did have some relevance for future prospects.

In addition to this initial information, citizens were also provided with information after completion of each bidding round. Prices for shares (defined as number of shares per investment points) were posted for each enterprise. The prices were based on a pricing formula established by a committee in the Federal Ministry of Finance which sought to clear the market for shares as soon as possible using a discriminatory price rule.⁹ In addition, data was provided on

^{9/} The pricing policy was based on the following guidelines: (1) where demand for shares exactly equaled supply, all enterprise shares would be sold in that round; (2) where a firm's shares were undersubscribed, those that bid received shares at that price and the remaining shares were offered in the next bidding round at a lower price; (3) where there is excess demand for shares that is less than 25% of the shares on offer, individual citizens' demand was given priority over the investment funds; (4) where the excess demand exceeds 25%, all shares are offered again in the next bidding round at a higher price with the magnitude of the adjustment as a function of relative demand.

demand and supply of shares after each bidding round, the price in the previous round, the proportion of shares purchased by individual citizens versus investment funds, and the number of shares remaining for bids in the subsequent round. Participants could of course use this intermediate information to alter their bids in response to new information.

The design of the scheme, based on open, sequential bidding rounds that were conducted simultaneously across the country, served to generate information and create externalities for uninformed bidders. The bidding rounds themselves served to put information about enterprise values into the public domain by allowing increasingly informed bidders to interact. This is in contrast to other types of auction markets. For example, a single simultaneous bidding round that allows agents to make multiple bids (thereby revealing their demand curve) could have been used, but would have favored those who had access to privileged information and generated no intermediary information for other bidders. Similarly, an auction that was not simultaneous, but was conducted individually for each enterprise (similar to that in Russia or in Lithuania) would not have generated the relative price information that facilitated the emergence of a market equilibrium.

Converging to Equilibrium Prices

All shares were priced at 3 shares per 100 voucher points at the start of the first bidding round. The theoretical market clearing price, which would equilibrate the supply of shares with the demand in total points, was 3.5 shares for 100 points at the start of the first round. Of course the starting price was fairly arbitrary, and the objective of the bidding rounds was to define relative prices for all enterprises from this arbitrary base.

In order to assess how agents used the market information provided to them to determine relative prices of enterprises' shares, a series of cross-section regressions using ordinary least squares has been run for each bidding round with the change in share prices on the left hand side

in each round and enterprise characteristics in 1991 on the right hand side for 1490 enterprises in the voucher scheme:¹⁰

$$P_{it} - P_{i,t-1} = a_0 + \sum_{1..n} a_n(\text{characteristics})_i + a_{n+1} \text{Dev}_{i,t-1}$$

where "P" is the price of enterprise "i" at time "t". The "n" enterprise characteristics (which are listed in table 1) include: book value, employment, equity/labor, equity/output, profit/output, profit/equity, employment/output, liabilities (mainly debt)/equity, share of equity bought by a foreign investor, share of equity bought by a domestic investor, labor force, region, and dummies for whether the enterprise is based in the Czech or Slovak Republic. After the initial bidding round, the deviation of an enterprise's share price from the average was also included and defined as:

$$\text{Dev}_{i,t-1} = \text{Average Price}_{t-1} - P_{i,t-1}$$

or the average price in round t-1 minus enterprise i's price in the previous round. This price deviation variable could be considered a proxy for the relative market return associated with an asset in a CAPM framework. The percentage of shares sold in the previous round out of the total offered in that round was also included as an explanatory variable. Because the left hand side variable is defined as shares per points, implying that cheaper shares have higher values (a bidder would get a larger number of shares per points bid), the signs of the right hand side should be interpreted as follows -- a positive sign indicates that the variable has a negative effect on the share price while a negative sign indicates a positive effect on share prices. Although there were five sets of prices posted for shares, there were actually four rounds of bidding since the prices in the first round were arbitrarily set.

^{10/} One enterprise was dropped from the sample because of insufficient data.

Table 1: Price Determination in Bidding Rounds.

ENTERPRISE CHARACTERISTICS 1/ Equation	CHANGE IN PRICE			
	ROUND 1 1.1.	ROUND 2 1.3.	ROUND 3 1.3.	ROUND 4 1.4.
Constant	0.02 (17.06)**	0.05 (8.80)**	-0.04 (-17.60)**	-0.03 (-18.35)**
Book value	-0.00 (-1.33)	-0.00 (-3.05)**	0.00 (2.58)**	-0.00 (-0.14)
Employment in 1991	0.00 (4.20)**	0.00 (8.97)**	-0.00 (-8.50)**	0.00 (1.86)*
Equity/Employment	0.00 (1.58)*	0.00 (3.46)**	-0.00 (-4.48)**	-0.00 (-0.69)
Equity/Output	-0.00 (-0.37)	0.00 (0.27)	0.00 (1.92)*	0.00 (1.78)*
Profit/Output	-0.01 (-4.87)**	-0.00 (-0.34)	-0.00 (-0.73)	-0.00 (-0.32)
Profit/Equity	-0.01 (-6.48)**	0.00 (0.40)	-0.00 (-0.61)	0.00 (0.07)
Employment/Output	0.15 (1.18)	-0.53 (-0.87)	-0.26 (-1.31)	0.04 (0.30)
Liability/Equity	0.00 (1.85)*	-0.00 (-2.48)*	0.00 (0.76)	0.00 (1.74)*
Share of equity for foreign owner	-0.00 (-7.67)**	0.00 (0.96)	0.00 (0.70)	-0.00 (-0.43)
Share of equity for domestic owner	-0.00 (-7.07)**	0.00 (0.85)	0.00 (0.17)	-0.00 (-0.76)
Republic 2/	0.01 (4.20)**	0.03 (3.60)**	0.00 (1.41)	0.00 (1.08)
Price deviation from average prices in the previous round		-2.71 (-20.30)**	0.32 (42.37)**	0.43 (55.04)**
Percentage of shares sold in previous round (out of total shares offered in that round)	0.00 (1.07)	0.01 (0.81)	0.03 (6.75)**	-0.00 (-0.64)
R-squared	0.17	0.38	0.70	0.74
Adjusted R-squared	0.16	0.35	0.69	0.73
S.E. of regression	0.03	0.13	0.04	0.03
Log likelihood	3066.97	835.35	2221.68	2465.53
Durbin-Watson stat	1.87	1.91	1.83	1.98
F-statistic	23.97	57.59	224.59	256.09
Number of observations	1421	1348	1295	1214

Note:

1/ The left hand side variable is defined as shares per points, implying that cheaper shares have higher values, a positive sign on a right hand side variable should be interpreted as a negative effect on the share price while a negative sign indicates a positive effect on share price while a negative sign indicate a positive effect on share price.

2/ The Republic dummy used was 0, 1, for Czech Rep and Slovak Rep for all the rounds.

* Indicates significant at 5% level of significance.

** Indicates significant at 1% level of significance. The "t" statistics are in parenthesis.

First Bidding Round: Revealing Initial Information. The spread in prices after the first round of bidding ranged from a minimum price of 10 shares for 100 points and a maximum price of 400 points for 1 share -- equivalent to a forty-fold spread from the lowest to the highest price shares. The first equation in table 1 indicates clearly that profitability, the size of the enterprise's labor force, the presence of a major domestic or foreign strategic investor, and the Republic in which the enterprise is located (with a negative premium on Slovak firms)¹¹ are the major determinants of the differentiation in prices between rounds one and two. Large labor forces were a negative factor, although not book value, implying that it is not size per se, but large workforces that tended to be associated with negative price adjustments. In contrast, high profitability (relative to output or to equity) had positive effects on prices as did the presence of strategic investors likely to play an active role in governance.¹² High capital/labor and debt/equity ratios also have significant negative effects on price adjustment, albeit at the 5% level.

However, these right hand side variables, which reflect the "fundamentals" of enterprises' past performance, explain only about 16% of the variation in prices after the first bidding round, implying that private information (such as reputation or insider information) played an

^{11/} The importance of the Republic dummy is consistent with the observed behavior of both investment funds and individuals after the first round of bidding. Ninety-nine percent of Czech individuals bid for Czech firms and 95% of Czech-based IPFs bid for Czech firms. In Slovakia, 81% of individual investors also concentrated on firms in their own Republic, but only 53% of the points of Slovak IPFs were allocated to Slovak firms. Thus all individual investors tended to focus on enterprises in their own Republics, possibly because of familiarity with certain enterprises and owing to fears about legal complications associated with the impending break-up of the Federation. In the case of the IPFs, there was a divergence with Czech IPFs concentrating on Czech enterprises whereas Slovak IPFs spread their bids almost evenly across the two Republics.

^{12/} Foreign investors in the Czech Republic concentrated on 41 enterprises in which the foreign investors share averaged 39%. In Slovakia, foreign investors bought half as many shares, which were even more concentrated in 10 enterprises and also averaged 39% of the shares in these firms. Domestic direct investment was actually more important for enterprises in the coupon scheme than foreign investment. In the Czech Republic, domestic investors bought holdings that average 41% of shares concentrated in 90 enterprises. In Slovakia, domestic investors concentrated on 31 enterprises with holdings averaging 36%.

important role. Although the published information on enterprise characteristics could not explain all of the movement in prices after the first round of bidding, there is interesting anecdotal evidence about the degree to which bidders did use the information provided by the government about enterprise performance. In one famous case, a typographical error resulted in an extra zero being added to the profits of a hotel being offered for privatization. At the end of the first round of bidding, demand for shares of the hotel were about 400 times the supply of shares -- implying that bidders did rely on published data in addition to "insider" information. This hotel became the maximum price enterprise entering the second bidding round.

Second Bidding Round: Investment Pause and Quality Focus. The results of the second bidding round reflected in equation 1.2 indicate that while some enterprise characteristics continued to play a significant role in explaining price changes (such as size, capital intensity and location), others ceased to be significant. In particular, profitability and the presence of a strategic investor were no longer important for price changes, since this information had already been incorporated into the price levels that emerged after the first bidding round. The coefficient on the price deviation variable, which captures the extent to which an enterprise's price was an "outlier," emerged as far more significant than any other explanatory variable, implying that such dynamic relative price information became more important for price changes than the static information on enterprise characteristics. The negative sign of the price deviation variable indicates that there was a tendency for price divergence during the second bidding round as enterprises with differing prospects became differentiated after information had been revealed after the first round. The inclusion of this price deviation variable also served to more than double the overall explanatory power of the regression.

Ultimately, the average price of shares sold was 2.28 per 100 points, implying that it was the more expensive shares that tended to sell as bidders tried to secure shares in very desirable

enterprises for relatively low prices in the early stage of price differentiation. Because equilibrium prices were emerging only for high priced shares, there were a large number of enterprises in which there was little interest after the first two bidding rounds, especially large companies in heavy industries. There is some evidence that the government's price committee adjusted share prices excessively downward for enterprises in which there was little market demand after the first two rounds. Therefore, the price divergence that emerged at the start of the third round was the greatest, with the minimum share price at 97 shares for 100 points and the maximum of 1 share for 800 points – equivalent to a 776-fold spread between the highest and lowest price firms.

Third Bidding Round: Market Divergence and Bargain Hunting. There was a surge of demand in the third round, especially by individuals who had restrained from bidding in previous rounds to see what information would be revealed about possible equilibrium values for shares.¹³ There was substantial "bargain-hunting" in the third round as bidders focused on low priced shares. The average price of shares for which there were bids fell dramatically from 3.04 per 100 points in the second round to 13.76 per 100 points in the third round. The differences in bidding behavior across republics persisted and was increasingly reflected in price divergence as the average price of shares bought in the Czech Republic was 2.55 per 100 points while it was 5.59 per 100 points in the Slovak Republic.

The results for the third round reported in equation 1.3 of table 1 are similar to the previous rounds because of the importance of the price deviation in improving the overall explanatory power of the regression. However, after the third round of bidding, the sign of the price deviation variable is positive – implying a tendency for converging behavior as the prices of outlying firms

^{13/} Participation rates between individuals and funds differed considerably in the early rounds. For example, the funds bid 92% of their points in the second round whereas individuals bid only 78% of their available points. The investment funds bid aggressively throughout the process for fear of having worthless points remaining after the final round. However, individuals could also afford to wait because the price clearing mechanism favored individual bidders by reducing the allocation of shares for the investment funds when excess demand for shares was less than 25%.

tended to return to the average. In addition, the lagged price is significant for the first time and the positive sign is consistent with the evidence of converging behavior. Because of these signs of market convergence, the minimum share price was actually raised going into the fourth round -- from 97 shares for 100 points to 60 shares per 100 points -- and the maximum price was only increased by 25% -- from 1 share for 800 points to 1 share for 1000 points. This reduced the spread between the highest and lowest price firms to 600-fold, from the high of 776-fold at the start of the third bidding round.

Fourth Bidding Round: An Emerging Equilibrium. The government announced that the prices that emerged after the fourth round of bidding (i.e. the prices posted in round 5) would be the final ones because there were a number of signs that the market had cleared. Thirty-six funds had exhausted all of their points and 22 funds had less than 100 points remaining. By the final round of bidding, the informational content of the information on enterprise characteristics had been completely absorbed into the price level. Thus these variables are almost all insignificant in explaining the change in prices during the final bidding round in equation 1.4. The significance and sign of the price deviation variable again indicates the importance of relative price information in the convergence toward equilibrium prices. The relative price information also plays a crucial role in the significant improvement in the explanatory power of the regression, with an adjusted R^2 of 0.73. The average selling price in the fourth round was 10.68 shares per 100 points, implying that the equilibrium in lower priced shares had finally emerged after the overshooting that had occurred in the previous round. By the fifth round, 92.8% of all shares had been sold and 98.8% of all points had been used. The majority of shares in the 1491 enterprises included in the scheme were sold, with the exception of 117 enterprises which were characterized by excess demand and would be privatized by other means.

The Importance of Revealed Market Information

Because information revealed in each round is embodied in the price that emerges from the bidding in that round, lagged prices should be an indicator of revealed market information. Table 2 provides estimates of the importance of lagged prices for price determination in various rounds using an AR (1) specification:

$$P_k = f(P_{k-1}).$$

There was no informational content in the arbitrary prices set in the first round, so nothing is reported for the second round. In the third round, the autoregressive component of prices was 34%, although the extremely low R^2 is an indicator that prices were still far from equilibrium levels. By the fourth round, the autoregressive component of prices had reached 65% and the extremely high R^2 is consistent with other indicators of market convergence in that round. By the fifth round, the coefficient on the autoregressive variable falls slightly to 58% but the R^2 remains high at 84%. By the final rounds, prices were behaving like a "random walk," which is consistent with expectations about how an efficient asset market would function.¹⁴

Table 2 also provides results for changes in prices:¹⁵

$$\Delta P_k = f(\Delta P_{k-1}).$$

which capture the oscillating equilibrium that emerged from the bidding rounds. The significance of lagged price changes indicates that there was some delay in processing information, consistent with a partial adjustment model of price formation.

^{14/} For survey of the literature examining individual autocorrelation as a test of the efficient markets hypothesis, see Fama, E. (1970), "Efficient Capital Markets: A Review of Theory and Empirical Work," Journal of Finance, 25, pp. 383-417.

^{15/} Again, because there was no informational content in the arbitrary prices set in the first round, the change in prices between rounds 1 and 2 carries no market information and is not included here.

Table 2: Role of Lagged Price in Determining Price Levels and Changes in Bidding Rounds

LAGGED PRICE/DIFFERENCE	PRICE LEVEL IN ROUNDS			PRICE DIFFERENCE IN ROUNDS	
	3	4	5	4	5
EQUATION	2.1.	2.2.	2.3.	2.4.	2.5.
P2	0.34 (2.10)*				
P3		0.65 (90.84)**		-0.04 (-3.05)**	
P4			0.58 (79.83)**		0.84 (17.53)**
R-squared	0.00	0.86	0.84	0.01	0.20
Adjusted R-squared	0.00	0.86	0.84	0.01	0.20
S.E. of regression	0.18	0.04	0.03	0.08	0.13
Log likelihood	380.59	2141.01	2456.88	1457.36	727.46
Durbin-Watson	1.84	1.75	1.97	1.93	1.74
F-statistic	4.42	8251.92	6373.96	9.32	307.57
Number of Observations	1296	1295	1214	1295	1214

Notes:

The "t" statistics are in parenthesis.

- * Indicates significant at 5% level of significance.
- ** Indicates significant at 1% level of significance.

The negative sign of the lagged price change for round four confirms the reversal after the overshooting of prices in round three – a large positive change in prices in round three was followed by a negative adjustment in round four, and vice versa. In contrast, the positive sign for the change in prices in round 5 indicates convergence toward equilibrium as prices adjusted in the same direction after round 4.

The importance of lagged prices is capturing both a market phenomenon and the market's rules. The increasing coefficient size and explanatory power of lagged prices over time indicates that such revealed price information, rather than enterprise characteristics, mattered more for

the emergence of the equilibrium, particularly in later rounds. In addition, the pricing rule used to post new prices at the start of each bidding round relied on past prices, and relative supply and demand for shares to set prices in subsequent rounds.

There is also evidence that individual citizens relied on information revealed by the investment funds to guide their bidding. The superior information about enterprise prospects gathered by the funds could be used most effectively in the first bidding round when it was still private information. By the second bidding round, there is a clear correlation between citizens' demand for shares in a particular enterprise (i) in round two (DEMCIT₂) with investment funds demand in round 1 (DEMIPF₁)

$$\text{DEMCIT}_{2} = 18902.9 + 0.19 \text{ DEMIPF}_{1} - 0.07 \text{ DEMCIT}_{1}$$

(8.12) (23.83) (3.39)

$$\begin{aligned} R^2(\text{adj}) &= 0.37 \\ DW &= 1.96 \\ F \text{ statistic} &= 432.07 \end{aligned}$$

where the "t" statistics are reported in parenthesis below the coefficient estimates. Interestingly, citizens' own bids were negatively correlated with each other, implying that they trusted the judgment of the funds more than that of other citizens. In contrast, investment fund bids were highly correlated with each other, but not with bids by citizens:

$$\text{DEMIPF}_{2} = 6198.53 + 0.59 \text{ DEMIPF}_{1} - 0.33 \text{ DEMCIT}_{1}$$

(2.07) (57.65) (12.32)

$$\begin{aligned} R^2(\text{adj.}) &= 0.76 \\ DW &= 1.98 \\ F \text{ statistic} &= 2312.98 \end{aligned}$$

Thus the market appears to have recognized the superior information that the investment funds possessed and uninformed bidders used this information, which was revealed after the first round, to

generate a more informed equilibrium. There was also an inherent bias in favor of citizens realizing their bids as a result of the pricing rules. Where there was excess demand for an enterprise's shares that was less than 25% of the shares on offer, individual citizens' bids were given priority over investment funds.

Determination of Equilibrium Price Levels

The determinants of equilibrium price levels are analyzed in table 3 with all right hand side variables included as levels and as logs. The left hand side variable is the price in the fifth bidding round (defined as shares per number of points bid) or the final price at which all shares were sold in a previous bidding round. Observations were excluded for twenty-two enterprises where more than 50% of their shares remained unsold after the fifth bidding round on the assumption that this final price could not be considered an equilibrium price.

The results in the levels (equation 3.1) are broadly consistent with the determinants of price adjustment in each round described previously. Positive effects on prices result from high rates of profitability and the presence of strategic investors. Since domestic and foreign strategic investors tended to take sizable stakes (averaging 40% of an enterprises' shares), their participation increased the likelihood of effective governance in the form of a majority shareholder. The Republic in which an enterprise was located had a negative effect on price – consistent with the 40% discount at which Slovak enterprises sold.

Large size (as measured by labor force size) has a significantly negative effect on the price of shares. This would seem to imply that the number of employees was a better indicator of size (especially given socialist accounting practices whose low rates of depreciation tended to overstate the value of capital assets). The size of the labor force was probably a good indicator of political importance, possible union activity and likely future state intervention in an enterprise, all

factors which appear to have had a negative effect on price. In those enterprises where size negatively affects share prices, it is overmanning, that has adverse effects, while highly productive workers are an asset. Large labor forces and very capital-intensive production (as measured by the capital/output ratio) are associated with low share prices.

However, it is interesting to note that when employment is included as a squared terms, it is also significant. This implies that the effect of size on price is a "U-shaped" quadratic – that large size has a negative effect up to a point (which is defined as more than 22,000 workers), after which it has a favorable effect on price. This level of employment is unusual -- with the average labor force in the sample of 850, with a minimum number of 6 workers and a maximum number of 34,231. Therefore large labor forces have consistently negative effects on share prices for virtually all of the sample range, with only two enterprises observed to have a labor force in excess of the turning point of 22,000 workers.

Equation 3.2 reports the results of a regression in logs.¹⁶ Perhaps the most striking result is that the explanatory power increases almost threefold. In the levels regressions, the characteristics variables could explain about 10% of the variation in prices. In logs, the adjusted R² increases substantially, enabling the characteristics to explain 29% of the variation in prices. The significance of the variables also changes slightly, with the size of the labor force, book value, the capital intensity of the enterprise (measured by the capital/labor ratio) indebtedness, and the Republic in which an enterprise is located all associated with lower prices, while participation by domestic of foreign direct investors is associated with higher prices.

The major difference in the log results is the diminishing importance of profitability and the significance of book value, instead of employment, as an indicator of size. Not surprisingly,

^{16/} Because some observations for profits and liabilities had negative values, a constant was added in order to calculate a logarithmic value.

book value and employment are closely associated, with a correlation coefficient of 0.61. However, it is interesting to note that the turning points for book value in equation 3.2 and for employment in equation 3.1 occur at very different points in the sample range. Given that the average book value in the sample is about Kcs 380 million (about \$11 million), the turning point of about Kcs 400,000 occurs at a fairly low book value, which is close to the sample mean, implying that the market viewed small size as advantageous only at very low levels of book value, after which size had favorable effects on share prices. Thus large, well known enterprises may sell for higher prices because of reputation premiums or because they are "too big to fail" and there are expectations of a government bail-out in the future if there are problems. The popularity of commercial banks' shares, which sold for very high prices despite widespread awareness of bad loan portfolios, would seem to reflect expectations that such important enterprises would not be allowed to go bankrupt.

Because the coefficient estimates in equation 3.2 can be interpreted as elasticities, the relative importance of the explanatory variables can be assessed. Thus the most important factors for price determination were size (with an elasticity greater than one), capital intensity and the Republic of location. This is consistent with the widespread view that heavy industries (of which there were relatively more in the Slovak Republic) had more adverse prospects. Foreign investor participation played a more important role than domestic investor participation, implying that bidders were willing to pay a premium for foreign expertise.¹⁷

It is interesting to note that even in the best fitting regression in table 3, the "inherent" characteristics of enterprises provided as official information could never explain more than 29% of the variation in price levels across enterprises. The remaining differences must be attributed to unofficial sources of information about enterprises' performance obtained prior to the bidding rounds or revealed in the process of bidding.

^{17/} This is consistent with results from Mexico which indicate that foreign participation tended to increase the price which government received when privatizing state-owned enterprises, see López-de-Silanes (1994), "Determinants of Privatization Prices" Mimeographic, Harvard University, Cambridge, MA, January.

Table 3: Determinants of "Equilibrium" Price Level in Final Round

<u>ENTERPRISE CHARACTERISTICS 1/ Equation</u>	<u>LEVELS</u>	<u>LOGS</u>
	<u>3.1.</u>	<u>3.2.</u>
Constant	0.06 (14.75) **	-13.07 (10.32) **
Book value	0.00 (0.82)	1.14 (3.41) **
Employment in 1991	0.00 (5.38) **	0.61 (2.25) *
Equity/Employment	0.00 (1.48)	0.67 (4.15) **
Equity/Output	0.00 (3.42) **	
Profit/Output	-0.02 (3.10) **	-0.12 (1.39)
Profit/Equity	-0.01 (3.52) **	0.03 (0.30)
Employment/Output	-0.35 (1.02)	0.46 (5.80) **
Liability/Equity	0.00 (0.14)	0.14 (5.78) **
Share of equity for selling to foreign owner	0.00 (3.25) **	-0.35 (6.74) **
Share of equity for selling to domestic owner	0.00 (3.03) **	-0.26 (6.90) **
Republic 2/	0.03 (6.45) **	0.61 (7.17) **
Book value squared	0.00 (0.09)	-0.05 (4.62) **
Employment squared	0.00 (3.37) **	-0.01 (0.74)
R-squared	0.10	0.30
Adjusted R-squared	0.10	0.29
S.E. of regression	0.08	1.00
Log likelihood	1542.89	-2083.33
Durbin-Watson stat	1.92	1.84
F-statistic	13.05	50.85
Number of observations	1468	1468

Note:

- 1/ The left hand side variable is defined as shares per points, implying that cheaper shares have higher values, a positive sign on a right hand side variable should be interpreted as a negative effect on the share price while a negative sign indicates a positive effect on share price.
 - 2/ The Republic dummy used was 0, 1, for Slovak Rep and Czech Rep in level terms; while it was 1,2, for the Czech Rep. and Slovak Rep. in log terms.
- * Indicates significant at 5% level of significance.
 ** Indicates significant at 1% level of significance. The "t" statistics are in parenthesis.

Concluding Remarks

The central challenge of the transition from central planning is how to create markets where none existed previously. The Czech and Slovak Republics had been economies in which 98% of assets were in state hands and private property rights, much less asset markets, did not exist. The mass privatization scheme was designed in a way that reflects an appreciation of what makes markets work -- a set of clear rules, that maximiz the public good character of information, and an enforcement mechanism that is impersonal and fair. This design served to improve the relative price discovery process by overcoming informational asymmetries among market participants.

The econometric results presented here indicate the way in which this artificially created market used information to converge to an equilibrium. Public information on enterprises' past performance clearly mattered, despite the poor quality of the data, especially in the early rounds when private information had not yet been revealed. However, public information about past performance alone could never explain more than 29% of the variation in the ultimate equilibrium prices. Attempts to explain stock price changes in the United States using data on systematic economic influences, the returns on other stocks in the same industry and by public firm-specific news events obtain other strikingly similar results.¹⁸ In the Czech and Slovak Republics, information about enterprise prospects revealed through the bidding process -- through lagged prices or through the deviation of prices from the averages in each round -- where the key to the emergence of equilibrium prices. This market information could explain about 85% of the variation in prices by the final rounds. Of course private or "insider" information about enterprise prospects was important throughout the process, but much less so over time as prices increasingly behaved like a random

^{18/} See Roll (1988) who finds an adjusted R^2 of only 0.35 with monthly data and 0.20 with daily data. Roll, R. (1988), "R²", The Journal of Finance, volume 43, number 2.

walk. Bidders obviously learned quickly from each other, as evidenced by the correlation between citizens' bids and investment funds' bids in the previous round as well as by the diminishing size of the residual that could not be explained by lagged prices in the later bidding rounds.

Other approaches to mass privatization rely more heavily on the "secondary market", when shares will be traded on the stock exchange, to generate an appropriate assessment of asset values. The initial valuation that emerges from the "primary market" may seem even less of an issue in give-away schemes such as mass privatization when compared to conventional stock flotations where the initial valuation affects government revenues. But if improved information is the first step toward more efficient asset markets and corporate governance, then the participants in the Czech and Slovak mass privatization scheme have a head start on other transition economies.

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