LANGE AND HAYEK REVISITED: LESSONS FROM CZECH VOUCHER PRIVATIZATION

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Since the sudden demise of communism in the late 1980s, economists have regarded the transition from command to market economies in Central and Eastern Europe with intense interest. In addition to studying the transition, they have begun using the region as a testing ground to investigate the validity of classic propositions. Vouchers were used to privatize substantial portions of the economy in several transition countries in Central and Eastern Europe. The core of these voucher schemes was use of artificial money (vouchers) to purchase shares of privatized companies in several waves of closed auctions. Since policymakers in these countries were typically afraid to employ open financial markets even in the few cases where such markets existed, most countries used administrative price committees to set the prices of shares in these auctions.

Voucher privatizations, therefore, quite unintentionally provided an empirical test of one of the key issues in an almost forgotten, but once famous, controversy in the economic theory of socialism: whether a socialist economy (whose *differentia specifica* was the public ownership of the capital and natural resources) could allocate its resources to replicate a perfectly competitive outcome. Simply put, the question was whether a system of government price administration could "get the prices right" in comparison with the competitive market.

Although the theoretical possibility of such an outcome has been known since the introduction of market socialism by Oskar Lange in

the 1930s (best summarized in Lange 1936 and 1937 and Neuberger 1973), the assumptions necessary for Lange's model to work were heavily criticized by Hayek and others (see Hayek 1935 for a good example), who argued that Lange's model is, in terms of information flows, equivalent to perfect competition.

Lange, referring to Wicksteed (1933) and Schumpeter, pointed to the so-called generalized meaning of price as being not only the exchange ratio between two commodities on the market but also (at a more fundamental level) the "terms on which alternatives are offered." He claimed that an actual market was unnecessary in order to find out these "indices of alternatives." Since this argument was inherently untestable, the focus of the controversy shifted to whether, in practice, a "nonmarket" solution could work. Robbins (1934) and Hayek claimed that practical application of the concept would require the price-setting authority to possess a great deal of information as well as solve hundreds of thousands of simultaneous equations that, once solved, would be obsolete. Lange, however, rejected these claims by asserting that both markets and planners operated using a "trial-and-error" algorithm. In fact, since both systems were operating by trial and error, Lange believed that convergence to the efficient outcome would be faster under planning due to the superior information content at the disposal of the planning authorities.

These predictions by Lange about the required informational content and the speed of convergence of such a "nonmarket" (or simulated market) approach represent the motivation for the current paper. Elsewhere, we have demonstrated that Czech voucher privatization was able to incorporate all information about future equity market prices into the administrative voucher prices and that, therefore, these prices were "efficient" in the sense usually used with respect to financial markets (Filer and Hanousek 2001). We now turn our attention to the more fundamental question in the Lange-Hayek debate: Was the administrative authority able to establish an equilibrium set of prices that was able to clear the relevant markets without significant excess demand or supply?

The Voucher Privatization Scheme

There were 1,664 companies that had some or all of their equity included in the two waves of voucher privatization.[1] The first wave

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[1] We present here only a brief summary of the Czech voucher privatization mechanism. For more detailed discussions, see Filer and Hanousek (2001), Hanousek and Kroch (1998), and Hlavsa (1996).

involved shares in 988 firms. The second included shares in an additional 676 firms plus unsold shares in 185 firms carried over from the first wave. The total book value of the equity privatized through vouchers was more than $14 billion, about 10 percent of the Czech Republic's national wealth.

All Czech citizens over the age of 18 were eligible to acquire 1,000 voucher points, the artificial currency used in the process.[2] Approximately 75 percent of eligible Czechs participated in each wave, making the book value of the shares available slightly more than $1,400 per participant in the first wave and $1,000 in the second wave.

Participants could bid for shares themselves or assign their voucher points to an investment privatization fund (IPF) in return for a share in the fund.[3] In the first wave 72.2 percent of participants turned their points over to one of 265 IPFs. In the second wave a somewhat smaller 63.5 percent of participants assigned their points to one of 349 funds. In addition to those who assigned their points to the funds, between 1.5 and 2 million individuals bid their points themselves. Each wave involved several rounds of bidding (five in the first wave and six in the second). Share prices were announced by the administrative authorities and participants submitted bids for the number of shares desired at the announced price. If the bids for a firm did not exceed its supply of available shares, these demands were satisfied and the remaining shares were deferred to the next round. If the demand for a firm's shares exceeded supply by less than 25 percent and the market could be cleared by prorating of the IPFs' demand, then individual investors had their demand met while IPFs were rationed proportionally to their bids.[4] In such a case, all shares were sold and the firm was not available in the succeeding rounds. If demand exceeded supply by more than 25 percent, then no bids were accepted and all shares were deferred to the next round.

The price, expressed as voucher points per share, was set by the price committee according to an unknown algorithm based on the ratio of demand to supply in the previous round and some other variables. According to official statements, the algorithm involved

[2]There was a nominal charge of 1,000 crowns (about $35 or one week's wages for the average worker) to cover administrative costs.

[3]Any fraction of an individual's points (in multiples of 100 points) could be turned over to a fund but this transaction had to be done prior to the start of the first round of bidding. See Allen and Smidkova (1998) and Hingorani et. al. (1997) for discussions of bidding behavior.

[4]In the first wave, IPF participation could be prorated only if their demand did not have to be reduced by more than 20 percent. For the second wave, this condition was removed.

about 20 factors, with additional ad hoc changes done manually (see Ministry of Privatization 1993, 1994), although the price committee announced that they adjusted prices mainly on the basis of the ratio of demand to supply in the previous round. Several observers remarked that the privatization authority appeared to use the rule of thumb of unitary price elasticity as a key for price setting (see Hlasva 1996, Shafik 1995, and Svejnar and Singer 1994).

For the first round share prices were set uniformly across firms at three shares per 100 points in Wave 1 and two shares per 100 points in Wave 2 according to the accounting value of the firm, so that each share represented the same book value (about 1,200 crowns for both waves) for every enterprise. Clearly these prices were far from equilibrium, so that in the first wave the ratio of demand to available supply in the first round of bidding ranged from less than 1 percent to 14,540 percent. After the first round there were substantial price changes. By the third round of Wave 1, for example, the lowest price was 1.03 points per share while the highest price had reached 1,000 points per share.[5]

A Test of Price Convergence

As pointed out in the previous section, the bidding scheme was a way to establish market prices where no market existed by using sequential market responses to adjust and administer the prices using an excess demand rule. Because of the high number of individuals involved, as well as the relatively high number of products (firms) on offer, voucher privatization can be considered a simulation of a small closed economy in which the pricing authority set the prices of goods (shares) using "consumer reactions." This provides a unique opportunity to test the ability of such a pricing authority to engender convergence to equilibrium prices. At the same time, we must recognize that voucher privatization as implemented in the Czech Republic was an inherently simpler process in which to establish equilibrium than a full economy with many thousands of products. Among the differences that made voucher privatization a relatively easy economy for a pricing authority to operate were:

1. The supply was exogenously determined. Thus, the pricing authority needed only to worry about the responses of demanders.
2. For profit maximizing investors all goods (shares) were perfect substitutes.

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[5]The detailed structure of the price by industrial sectors and rounds is available from the authors upon request (see also http://home.cerge.cuni.cz/hanousek/lange).

TABLE 1

EXTENT OF EXCESS SUPPLY
(THOUSANDS OF POINTS)

	Wave 1		Wave 2	
Round	Available Points	Points Required to Exhaust Supply	Available Points	Points Required to Exhaust Supply
1	6,835,627.0	7,083,043.0	6,158,720.0	7,750,000.0
2	4,580,293.8	4,965,459.0	5,112,295.6	5,709,697.3
3	1,642,654.7	2,026,129.8	2,990,576.7	3,518,736.6
4	821,769.0	1,155,213.3	1,967,929.0	2,543,364.3
5	438,743.0	753,791.9	713,641.2	924,719.2
6			202,590.3	320,450.2
Unspent points				
	75,405.1		39,338.6	

3. The pricing authority appeared to have been willing to tolerate aggregate excess supply, leaving some shares unsold at the end of the process. This may have been due to a desire to retain assets that the state could sell for income at a later date or it may have been because the administrators wanted to increase the probability that participants would not be left with unspent and, therefore, "worthless" points at the end of the process in order to avoid any political repercussions (see Hillion and Young 1996).

The excess aggregate supply embodied in the system can be seen in Table 1, which shows the total number of points available for bidding in each round as well as the total number of points that would be required to purchase all of the shares available at their announced prices. This systemic excess supply is especially critical since it gave the pricing authority a great deal of flexibility to misprice goods and still achieve a "quasi-equilibrium" price structure in the sense that all demands were satisfied. In other words, given the lack of a true supply side, price administrators in the voucher privatization scheme had the luxury of knowing that there were a large number of equilibrium price vectors that met the goal of eliminating excess demand for individual goods.

TABLE 2
FRACTION OF DEMAND SATISFIED BY ROUNDS
(PERCENT)

Round	Wave 1		Wave 2	
	IPFs	Individuals	IPFs	Individuals
1	39	26.4	20	15.8
2	53.9	46.9	17.9	8.7
3	17.2	7.8	17	14.3
4	37.4	39.7	53.5	54
5	87.9	84	80	76.7
6			83.8	82.6

Note that the question here is fundamentally different from that addressed in Filer and Hanousek (2001), which asked whether the prices resulting from the multi-round adjustment process were efficient in the sense of incorporating all relevant information about future values. Here we are concerned with whether these prices are equilibria in the sense of eliminating excess demands, recognizing that excess demand may exist even if prices are informationally efficient if there are uninformed or "noisy" traders in the market.

Table 2 shows that even under these very favorable conditions, the pricing authority was not able to achieve an equilibrium price vector during the five to six rounds of bidding in voucher privatization. The final round is especially interesting, given that the authorities attempted to manipulate demand in order to *ensure* that there was no unsatisfied demand. Prior to this round the authorities announced that prices would be set such that if all investors rebid for exactly the shares they were not able to obtain in the previous round (and all unbid points were bid for these shares in a ratio equal to their fraction of unsatisfied demand in the previous round), there would be no shares in excess demand in the final round.

As can be seen in Table 2, even in a world where the authorities were willing to tolerate excess supply and where they tried to explicitly manipulate demand, it proved impossible to set a price vector that eliminated excess demand. In the final round in each wave some 12 to 17 percent of demand was unsatisfied. Translated to a real economy, this implies significant queues as frustrated customers found that they were not able to have their demands satisfied. The situation in earlier rounds was even less favorable. After three price adjustments (i.e., in round four) between half and two-thirds of de-

mand was *unsatisfied*. Thus, these prices were a long way from equilibria even in this much simplified economy.

Conclusion

A fundamental question in economics for the 60 years between the 1930s and the 1990s has been whether there might exist an administrative price system that could simulate the results of perfect competition even without true markets. We have used the artificial bidding market that occurred as a part of Czech voucher privatization to test whether such equilibrium prices can be achieved in a *de nova* market. We find that at the conclusion of this process prices were still far from equilibrium in that significant excess demands existed despite the lack of a true supply side of the market and the willingness of the pricing authorities to tolerate significant excess supply. If the Czech pricing authorities were unable to find even one out of the several possible price vectors that would eliminate excess demand in four or five adjustments of an "economy" with less than 1,000 products, there seems little chance that socialist planning authorities could have hoped to achieve market-clearing prices in a far more complex real economy with several thousand products and a real supply side. Thus, it would appear from this natural experiment that Robbins and Hayek were correct in doubting the real-world feasibility of market socialism. Interestingly, the results presented here in combination with those of Filer and Hanousek (2001) suggest that the fundamental problem may lie less in the inability of the authorities to utilize relevant information than in their inability to incorporate the demands of nuisance or noisy traders into their prices.

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