THE WORLD BANK ECONOMIC REVIEW, VOL. 8, NO. 3: 415-443

The Welfare Costs of Price Controls for Cars and Color Televisions in Poland: Contrasting Estimates of Rent-Seeking from Recent Experience

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The welfare costs of price controls can vary enormously, depending on the method of allocating the good in shortage and the possible rent-seeking costs that may result. With full rent dissipation, the welfare loss from price controls on Polish color televisions in 1989 was about ten times the standard estimates of distortion costs, which ignore rent-seeking, and was more than 100 percent of the value of domestic producers' sales. The methods of allocating cars, however, did not result in rent-seeking costs. The domestic price controls were an unintended implicit subsidy to imports. Subsidies for cars were estimated at 43 percent and for color televisions at 22 percent.

Although the macroeconomic features and accomplishments of the Polish "Big Bang" reforms of January 1990 have been extensively analyzed and debated (see, for example, Rocha and Coricelli 1991; Rosati 1991; Pinto, Coricelli, and de la Calle 1990; and Lipton and Sachs 1990), the impact of the reform at the microeconomic level has been largely unanalyzed.[1] This article provides empirical assessments of two phenomena that have been frequently discussed but rarely estimated. The first is the microeconomic policy changes in socialist economies, in this case the benefits of price decontrol in the Polish automobile and color television industries, and of trade liberalization in the presence of domestic price controls. The second is the extent of rent-seeking activities in these markets and the relative magnitude of the traditional distortion costs compared with rent-seeking costs.[2]

1. Some examples of microeconomic empirical work in Poland include Konovalov (1989), Tarr (1990b), Milanovic (1991), and Jorgensen, Gelb, and Singh (1991).

2. When goods are allocated by nonmarket-clearing methods, such as price control, the value of the goods to the recipient typically exceeds the costs. Expenditures of resources by agents who compete to obtain such goods is referred to as rent-seeking. Deacon and Sonstelie (1985), Alderman (1987), Lindsay and Feigenbaum (1984), and Sah (1987) have estimated rent-seeking.

David G. Tarr is with the International Economics Department at the World Bank. The author wishes to thank Bohdan Wyznikiewicz for obtaining the data for this study and for many useful discussions; Fernando Saldanha for useful discussions regarding disequilibrium modeling; and Elias Dinopoulos and three anonymous referees for many comments that have significantly improved the article. He also thanks various officials in the Polish automobile and color television industries.

Section I outlines the theory of rent-seeking and how it applies to the automobile and color television industries in Poland. Section II discusses the institutional details of the automobile and color television markets in Poland, lays out the stylized facts that are incorporated in the model of these markets, and discusses the methods of allocating cars and color televisions in the context of the rent-seeking and rent dissipation literature. In section III a graphic version of the model is developed and interpreted and the results are explained. Section IV offers conclusions. The appendix develops a mathematical version of the model, which fits the stylized facts that prevailed in Poland in 1989. It is a differentiated product model in which consumers optimize their consumption expenditures across commodities subject to rationing constraints on their purchase of domestic cars and color televisions, and an implicit tariff on imports caused by the foreign exchange policy. Firms optimize their quantity choice subject to price controls. A model developed in the appendix analyzes the consumption-labor-leisure choice in the presence of price-controlled commodities that require queuing. The appendix also treats calibration of the model and derivation of cross elasticities in a model subject to rationing.

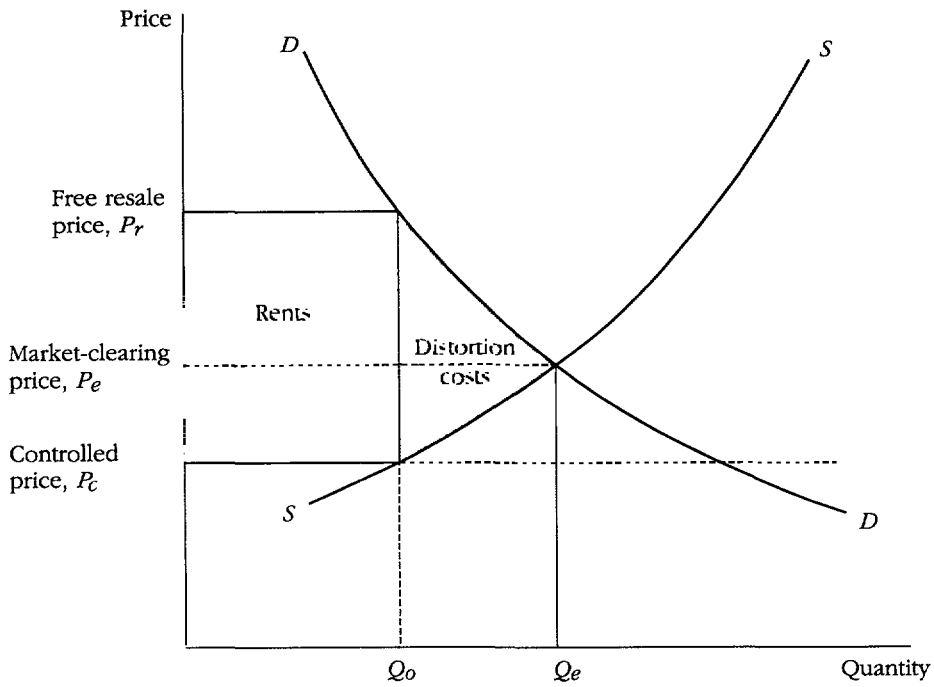
I. Rent-Seeking

Figure 1 depicts a competitive market under price control. Firms may not sell the good above the controlled ceiling price P_c. Thus, they choose to offer for sale the quantity Q_o, for which their marginal costs equal the controlled price. Because consumers at the margin value the quantity supplied at P_r, the value to consumers exceeds the marginal costs to society of producing the good. Thus, there are gains from expanding output up to the market-clearing quantity-price combination (Q_e, P_e). These gains, which would be realized by eliminating the price control, are the triangle ("Harberger" triangle) labeled "distortion costs" in figure 1.

Figure 1 also labels a rectangle "rents." Because the controlled price does not clear the market, a nonmarket method of allocating the good must be employed. Those who receive the good under nonmarket allocation receive a good valued at P_r at the margin (if free resale of the good is permitted, the price P_r will clear the resale market) but only have to pay the controlled price P_c. The difference between the value of the good on the free resale market and the cost to the recipient is defined as rents. A problem arises because if agents can compete to obtain the rationed good, they will expend resources in competing to obtain these rents (the activity known as rent-seeking). The expenditure of resources may be sufficiently great for all the rents to be dissipated; that is, the full cost to the recipient of the good under price control is P_r. In that case the rent rectangle is an additional cost to society of the price control. Because the rent rectangle is typically large in relation to the distortion triangle, the extent of rent dissipation is important.

The early theory of rent-seeking tended to focus on cases in which rent-seeking activities exactly dissipated available rents. One of the most important

Figure 1. *Rents and Distortion Costs in a Competitive Market under Price Control*



early models is that of Barzel (1974), in which the method of allocating goods in shortage is through queuing. An individual who is deciding whether to join the queue must assess the value of the rent received compared with the opportunity cost of time spent in the queue. The full price to the buyer is the money price of the good plus the opportunity cost of the buyer's time. Subject to an uncertainty premium (see Hillman and Katz 1984), the individual will join the end of the queue if the value of the rent exceeds the value of the individual's time. The queue lengthens until the full price to the buyer (including the opportunity cost of time) exactly dissipates the rents. This implies that the full price to the consumer rises to P_r (in figure 1), which is higher than the market-clearing price without a price control. Because the full price exactly dissipates the rents, queuing is a very inefficient method of allocating rationed goods.

One rationale for queuing is that if a distinction is made between consumers who have a high, as opposed to low, opportunity cost of time, it is those with the low opportunity cost of time who will choose to queue and obtain the goods. Insofar as these are likely to be poorer consumers, some will argue that there is an equity advantage to queuing as an allocation method. But if only those with a low opportunity cost of time queue, then the full cost to these consumers is the price P_r, which exceeds the market-clearing price even for these consumers. See

Table 1. *The Impact of Eliminating Domestic Price Controls on the Automobile and Color Television Markets in Poland*

	1988 data		*Low elasticities*		*Medium elasticities*		*High elasticities*	
Item	*Cars*	*Televisions*	*Cars*	*Televisions*	*Cars*	*Televisions*	*Cars*	*Televisions*
Domestic controlled price, P_c	1.27	0.394	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Domestic free price, P	3.54	0.788	2.52	0.610	2.52	0.610	2.52	610
Import price (tariff-inclusive), $p(1 + t)$	4.26	0.873	4.26	0.873	4.26	0.873	4.56	873
Domestic quantity, Q	177	294	210	327	250	365	351	455
Import quantity, q	61.6	156	43.5	135	30.7	117	15.2	87
Welfare gains								
Triangle of distortion	n.a.	n.a.	37	7	82	14	200	32
Rectangle of rent dissipation	n.a.	n.a.	0	116	0	116	0	116
Total	n.a.	n.a.	37	123	82	130	200	148
Welfare gains (percentage of)								
GDP	n.a.	n.a.	0.13	0.43	0.29	0.46	0.70	0.52
Domestic producers' sales	n.a.	n.a.	16.6	105.8	36.3	112.2	87.3	127.4
Domestic producers' sales plus imports	n.a.	n.a.	7.7	48.8	16.8	51.8	40.5	58.8
Subsidy equivalent to imports caused by the price controls[a]	n.a.	n.a.	44	23	43	22	42	21

n.a. Not applicable.

Note: Prices are in millions of 1988 zlotys, quantities in thousands of cars or color televisions, welfare gains in billions of 1988 zlotys or as a percentage of 1988 estimated GDP.

a. The percentage subsidy to imports necessary to reduce imports to their 1988 level, once price controls are removed.

Source: Author's calculations.

Sah (1987) for a formal derivation that even for the poor, queues are welfare-inferior to other rationing schemes. If there are transactions costs in reselling the product, the length of the queue and the amount of rent-seeking should be shorter in equilibrium because transactions costs reduce the rents. These transactions costs are also lost to society, so the full rent rectangle would remain as a cost to society.

In addition, buyers will incur transactions costs in the resale market. Because available data on the resale market exclude buyers' transactions costs, the extent of these costs is underestimated in the rent rectangle. The underestimate is likely to be small, however, especially for cars. As elaborated below, the value of the rents in the automobile market was about forty-six months of wages, but the transactions costs involved search costs of one to two weeks.

Another important model of full rent dissipation focuses on the expenditures of agents who lobby or compete to obtain a favorable allocation decision from the government. A number of models have been developed in which, depending on the nature of the market and the method of allocation of rents, wasteful rent-seeking activities may be greater or less than the available rents. Rent dissipation may be greater than available rents in the model of Deacon and Sonstelie (1989) and less than available rents in the models of Hillman and Katz (1984), Bhagwati and Srinivasan (1980), Bhagwati (1980, 1982), and Flowers (1987). See Tarr (1991) for a survey. A distinguishing empirical feature of the present study is that it examines in detail the methods through which cars and color televisions were rationed in Poland to assess the extent to which these rents were dissipated.

For color televisions in Poland in 1989, the early, more conventional view of exact and full rent dissipation appears appropriate because queues formed that dissipated the rents according to the model developed by Barzel (1974). This article estimates that rent dissipation under price controls equals about ten times the triangle of distortion costs, for a total cost of 0.46 percent of Polish gross domestic product (GDP), or 112 percent of the value of Polish producers' sales of color televisions (see table 1).

For cars, however, rationing was carried out through a variety of methods that, overall, did not increase the social costs of the price controls above the Harberger costs. For example, for a significant share of rationed cars, the allocation method was equivalent to the government's taxing the automobile sector and using the taxes it received to pay bonus payments to workers in other state-owned enterprises. Because these bonus payments were required to induce a greater supply of socially productive effort, they were not rents. Therefore, in cars with no rent dissipation, the triangle of distortion costs was the entire cost of the price control program; it equaled 0.29 percent of GDP, or 36 percent of the value of Polish producers' sales (see table 1).

II. The Markets for Cars and Color Televisions in Poland before the Big Bang

The foreign trade regime in Poland as of early 1989 was largely open. One significant exception was that exporting enterprises had to surrender, on aver-

age, 70 percent of their foreign exchange earnings to the central government at the official exchange rate. (See Tarr 1990c, Rosati 1991, Olechowski and Oles 1991, or UNDP/World Bank 1989 for further details of the trade regime in Poland in 1989. See Brown 1987 and Rodrik 1992 for studies of the impact of trade policy on Poland.) This requirement represented a significant disincentive to export, because the official exchange rate was about 20 percent of the parallel market exchange rate. As elaborated in Tarr (1990c), the punitive foreign exchange surrender requirements represented an implicit tax on imports. The requirements made less foreign exchange available for imports and depreciated the market exchange rate.

Although the import market in 1989 was distorted by the aggregate surrender requirements on foreign exchange, this was an implicit tax caused by the premium on foreign exchange rather than a quota on cars or color televisions. There was no license or right to import for which it was necessary to compete. Anyone with the foreign exchange could import a car or television. I assume, therefore, that there were no rent-seeking activities in imported cars or color televisions.

This section describes the basic structures of the automobile and color television markets in Poland in 1989. An important difference between the two markets was the method of allocating rationed domestic goods under price control.

Color Televisions

Imported and domestic televisions are not homogeneous; imported televisions are regarded as being of higher quality. Except for small tariffs and the implicit tax on foreign exchange, importing color televisions was free in 1989. It was not necessary to go through the official foreign trade organization to import a television, and foreign exchange was available (subject to the implicit import tax discussed above). Thus, the market for imported color televisions cleared.

Domestic color televisions were in severe shortage. The average domestic official price in 1988 was controlled at 394,000 zlotys (136 U.S. dollars at the parallel market exchange rate). At this controlled price, there was great excess demand. Because of the excess demand, the supplies were allocated in a negotiation process between producers and internal trade organizations (with a representative of the Ministry of Internal Markets present). The internal trade organizations are regional trade organizations that have retail outlets (one for each of the fifty voivodships or regions), rural cooperatives (CS Samopomoc Chlopska), and some small trading companies. Sometimes, in an effort to avoid the price controls, producers sold television sets to their suppliers, demanding goods or services that were also under price control in return, in the fashion described by Kornai (1980). Barter is inefficient compared with a well-functioning money-based payments system. With price controls, however, barter has a second-best benefit because it encourages greater production. A full treatment of this subject, however, is beyond the scope of this article.

The final consumers of the color televisions, who wanted to pay the official price, had to wait in front of the stores for days or weeks until a shipment arrived. Those who waited at the stores formed waiting lists, called "social waiting lists." The lists, through rules set by the customers, determined who had the right to buy a television at a particular store when a shipment arrived. Although there were cases in which the lists were operated by the staff of the stores, such cases were unusual. At least one person from the list had to be at the store at all times, or a newcomer could start a new list. Normal procedure obliged everyone on the list to appear at the store at least once a day at a designated time to keep his or her name on the list. There were cases of people taking leave from work to ensure that they would be able to buy a color television and of people who waited in line so they could resell a television. It appears that the best way to characterize the allocation of domestic color televisions is described by Barzel's (1974) model.

Domestic color televisions could be, and were, resold in open-air markets where goods (not limited to color televisions) were sold and through advertisements. The free-market price was periodically reported in newspapers, and in 1988 it was two times the official price. Thus, the resale market in Poland for color televisions (both new and used) cleared. The per-unit value of the rent (defined as the difference in the price on the resale market and the official price) could be directly observed, but that rent had likely been dissipated through lost time in the queue, so that the rents were an additional cost to society.

Cars

Polish cars and imported cars are not homogeneous products. Poland imported cars from a number of foreign countries, including Japan, Germany, Sweden, and the former Eastern bloc countries, most notably Czechoslovakia and the Soviet Union. Imported vehicles generally sold for considerably more than domestic vehicles (on the domestic free market), reflecting assessed quality premia for imports from Western countries.

After the decontrol of prices in January 1990, the market for domestic cars cleared. Before that, the market for domestically produced cars was characterized for many years by severe shortages. The official price of domestically produced cars was controlled at a level that induced great excess demand. The weighted average official price of a Polish-made car in 1988 was 1.27 million zlotys. At the parallel market exchange rate prevailing in mid-March 1989 (2,900 zlotys to one U.S. dollar), that was 434 U.S. dollars.

Given the existence of huge excess demand at the official prices, cars were rationed through two methods: a lottery system and "asygnata" (an assignment by government system). The Ministry of Industry and the Ministry of Internal Trade decided how to divide the cars available for domestic consumption. This included a decision on how many cars should go to the lottery or to the asygnata system. Cars in the asygnata system were available for allocation as intermediate input use in enterprises and, more significantly, for individuals. Asygnatas given

to individuals were awarded either by ministers (or committees acting on their behalf) or by directors of enterprises. Asygnatas were generally awarded to the staff of large organizations such as coal mines, central or local bureaucracies, physicians in rural areas, journalists, taxi drivers, handicapped persons, and groups associated with the Council of Ministers. Between 120,000 and 140,000 cars, out of 177,000 produced for the domestic market, were estimated to be in the asygnata system in 1988.[3]

A final key piece of the market for domestic cars in Poland was the free market for cars offered for resale. Resales occur at large open-air markets in Warsaw and a few other large cities. In addition, trades occur through advertisements in newspapers. In addition, a state-owned company, POLMOZBYT, resells domestic cars, and private individuals advertise in newspapers to sell cars for other individuals for a commission. Both new and used cars, domestic and foreign, can be bought and sold in the free market. In particular, the price of newly produced domestic cars clears on the resale free market. One important implication is that any individual willing to pay the market-clearing price can buy a domestic vehicle. A second important implication is that individuals receiving a vehicle at the official price receive a rent equal to the difference between the market-clearing price and the official price. Those individuals may choose to sell the car and capture the rent in cash or use the car because they value its use more than they value the price they would receive on the free market. In the latter case, they are consuming the rent. In either case, the producers of the cars do not receive the incentive to produce more cars at the higher price. A small number of cars are allocated to the domestic market for sale for hard currency; the price charged for these vehicles is close to the free-market price for domestic vehicles.

In December 1988, even the least expensive Polish car, the 126p, cost an estimated 17.5 months of wages for the average Polish worker at the official, controlled price. At the price on the free market, the 126p cost an average of 63.5 months of wages (*Gazeta Bankowa* 1989). Thus, the value of the rent from receiving an allocated car was worth approximately 46 months of wages.

During the late 1980s it was possible to import vehicles freely, provided that the buyer could obtain hard currency. Organizations, such as POLMOT, would import the vehicles for a quoted price in hard currency. The 1989 liberalization of organizations with the right to import opened this process to competition and reduced the profit margins of these importing organizations. Individuals could travel abroad and bring back a car or color televisions. (These are referred to as "private imports.") Although tariffs on imports through foreign trade organizations are very low (see the data appendix in Tarr 1991), private imports are subject to a special customs duty. The duty was high enough in 1985 to severely retard private imports, but because it was a specific duty in zlotys, the high rate of Polish inflation made it relatively unimportant by 1988. In addition, the mid-

3. Of the 293,000 cars that were produced, only 116,000 were exported; 103,000 of these were exported to non-CMEA (Council for Mutual Economic Assistance) countries.

March 1989 liberalization of the currency exchange, whereby Poles could freely exchange zlotys for dollars internally (at parallel market rates), implied that the market for imported cars cleared. Previously, it would have been necessary for some individuals to purchase dollars through the black market.

Regarding rent dissipation in cars, first consider the asygnata system. On the one hand, many automobile awards (such as groups favored by the Council of Ministers) likely did fit into the socially wasteful category of classical rent dissipation. That is, awards going to the politically favored and awards going to some professions involved lobbying-type activity that is socially wasteful; moreover, some of the activities involved may be socially counterproductive. For example, if society at large values a diverse press, but the allocation of awards to journalists facilitates the control of the press by nonrepresentative authorities, the awards are likely to be counterproductive. The "lobbying" by the journalists is not only a waste of resources but also conveys negative externalities on the rest of the economy.

On the other hand, when the cars were awarded to coal miners or factory workers who were assessed to be the most productive workers, the asygnata system played a socially useful function. A low level of effort and efficiency was reported in many state-owned factories and mines. Competition for these cars among factory workers raised productivity and was socially productive. It seems inappropriate, therefore, to define the allocation of cars to the most productive workers as rent-seeking. Rather, it is equivalent to the government's taxing the automobile sector (by requiring delivery of the goods to the government at the controlled price and reselling them at the market-clearing price) and using the taxes it receives to pay bonus payments to workers. Then the workers are merely receiving higher wages in accordance with their productivity, and because the bonus payments induce a greater supply of effort, the payments are not rents. In fact, in an economy under generalized shortages, the excess demand for goods implies from Walras's law an excess supply of money. Then payment in kind is usually a more effective method of inducing effort than cash payments are. Regardless of whether the payments to workers are called bonus wages or rents, the key point is that in Poland in the late 1980s these payments were not socially dissipated but rather added to output in the economy. That is, these payments did not contribute to dissipation of the rectangle of rents or add to the welfare costs to society of the price controls.

Now consider the lottery system, which forms a waiting list by random allocation. It is evident that little could be done in the way of lobbying to alter the timing of receipt of a car through the lottery system. In 1981, more than 1.5 million people entered the lottery for the right to buy a Polish-made car at the official price. The outcome of the lottery was that all participating individuals received the right to buy a car in a certain year. Lucky individuals received the right to buy the car in 1981 or 1982. Unlucky individuals received the right for later years throughout the 1980s. Individuals paid 50 percent of the official price of the vehicle to enter the lottery and agreed to make additional annual pay-

ments so that the price would be paid by the time their delivery date arrived. Insufficient numbers of cars were allocated to meet the requirements of the lottery system, however, so that in early 1989 there were about 400,000 people waiting for prepaid 126ps and 70,000 for prepaid FSOs.

Lindsay and Feigenbaum (1984) have shown that rent dissipation can occur with waiting lists even when no lobbying-type activities take place. Their model requires that the value of the product decline with the delay of receipt, because of considerations such as style changes or time of year of receipt. Polish cars, whose style used to change little from year to year, do not appear to fit into the category of products they analyzed.

Thus, the lottery system caused very little rent dissipation, and the asygnata system had socially wasteful or counterproductive effects as well as productive effects. It is impossible to determine which effects were dominant. For the purpose of the estimation I assume that, on balance, there was no socially wasteful rent dissipation from the price controls on cars. Because the judgment involves some arbitrariness, in the next section I also calculate the rent rectangle.

III. The Graphic Model and Results

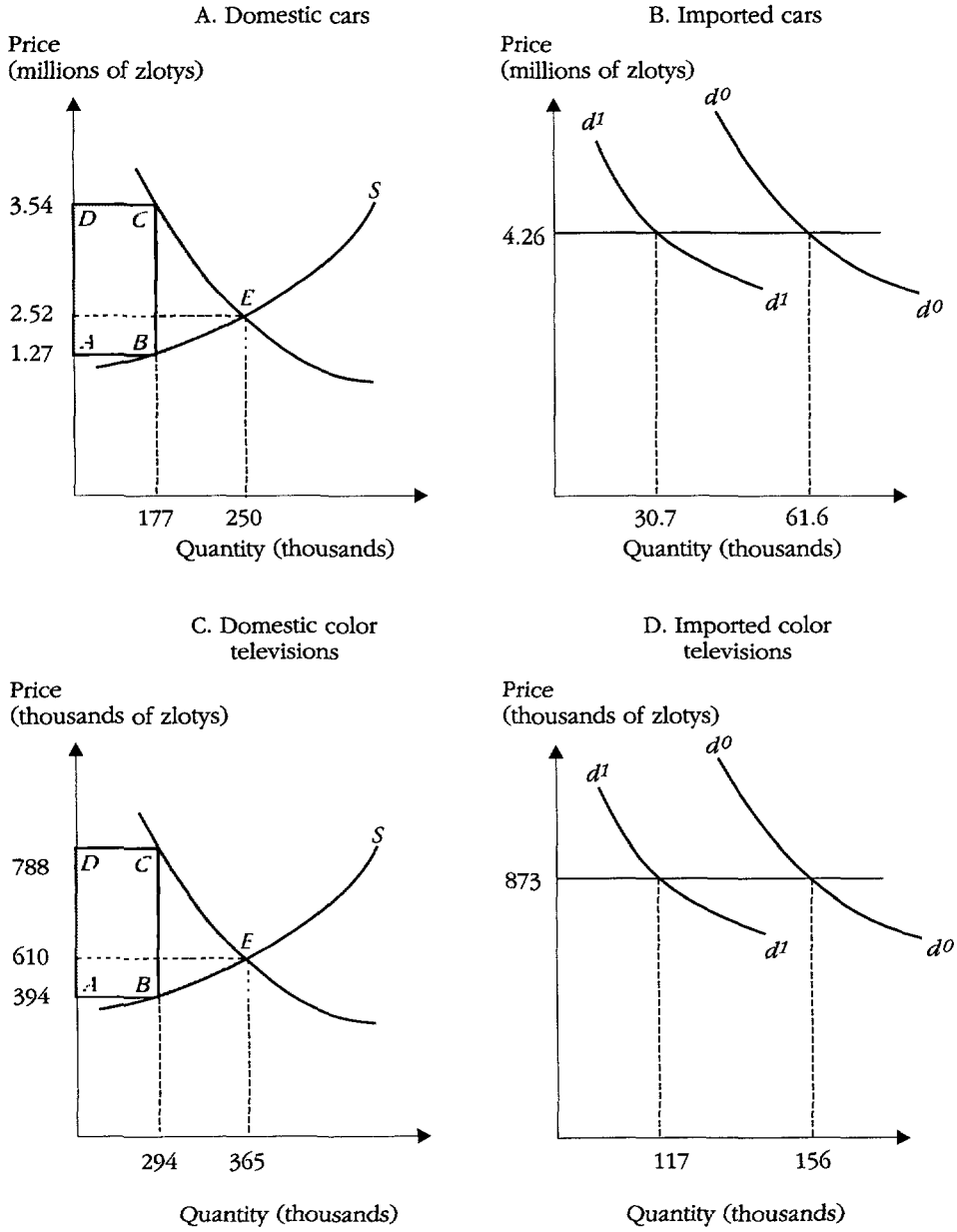
This section describes and interprets the model graphically. An algebraic characterization of the model is developed in the appendix, along with the derivation of the cross elasticities and an explanation of the elasticities chosen and the calibration procedures.

Price Decontrol

The first policy simulated is the elimination of price controls. The results, under different elasticity assumptions, are presented in table 1 and depicted in figure 2. The curve representing the initial equilibrium is depicted with superscript zero, and those of the new equilibrium after the policy shift are shown with superscript 1. If domestic price controls are removed, domestic output will expand because of the greater incentive provided by the higher prices. In the short run, the expansion of output is likely to be small because of capacity constraints, but I view this as a long-run model. The greater production of Polish vehicles and color televisions increases welfare because the value to consumers of additional domestic vehicles exceeds the opportunity costs of the resources to produce these vehicles. That is, there is a Harberger triangle of benefits equal to the area *BCE* in figure 2.

In the initial price control situation there is a rectangle of rents equal to *ABCD*. I have argued that for color televisions these rents were dissipated, so the value of this rectangle represents an additional gain to society when price controls are removed. In the central elasticity case, the rectangle of rents equals 116 billion zlotys (about 0.4 percent of Polish GDP, or 112 percent of the value of sales of domestic producers), which is about ten times the triangle of distortion costs. Moreover, unlike the distortion cost triangle (where the full gains to

Figure 2. *Impact of Eliminating Price Controls on Cars and Color Televisions in Poland*



Note: Estimates are for the medium-elasticity case.
Source: Author's calculations.

society will occur with a significant lag), the gains from the rectangle of rents were achieved very rapidly because the queues vanished almost overnight. Thus, the color television case is consistent with the view that, other things being equal, freeing prices results in an immediate and substantial improvement in the standard of living (Lipton and Sachs 1990).

In the case of cars in figure 2, the rectangle of rents equals 402 million zlotys, which is about five times the Harberger triangle costs of 82 million zlotys in the medium-elasticity case. As discussed above, however, the rectangle of rents did not represent an additional loss to society. Thus, despite the fact that the Harberger triangle for cars is about six times larger than for color televisions, the total benefits from price decontrol in color televisions are larger than those in cars. Increased production of domestic cars and color televisions reduces the demand for the import substitutes but has no effect on welfare because no price change occurs in the import market; that is, there is no change in the distortion. Given the estimate of 402 million zlotys for nondissipated rents in cars, and given the uncertainty regarding their nondissipation, the estimate of the rent rectangle can be added to the estimate of the distortion costs in cars if it seems that automobile rents are dissipated.

Estimates of the rents are invariant with respect to the elasticity assumptions. The reason is that points *B* and *C* in figure 2 are predetermined by the data. Therefore a change in the curvature of the demand and supply curves is permitted only to the extent that these curves pass through the points *C* and *B*.[4] Regarding the triangle of distortion costs, from figure 2, an increase in either elasticity will increase the triangle and hence increase the estimated benefits of removal of the price control.

An important implication of the model is that the controlled price on domestic cars (or televisions) led to an increase in the demand for the import substitute. Because of price control, any increase in the production of domestically produced cars is purchased, so the substitution effect of increased domestic cars on the demand for imported cars is strong. Moreover, the domestic controlled price is a parameter in the demand function for imported cars, and an increase in the domestic controlled price has the effect of decreasing demand for imported cars through an income effect. Because all cars produced under price control are consumed, there is no substitution effect for an increase in the domestic controlled price subject to continued excess demand. But the increase in the controlled price leaves less income for the purchase of all other goods, including imported cars. Moreover, the domestic free-market price does not affect import demand at all; it simply determines rents among consumers of the fixed quantity of domestic cars but does not affect the aggregate income available for the purchase of other goods by consumers in aggregate.

4. Starting instead from an equilibrium without price controls and considering the costs of *imposing* price controls, then the rents would be affected by the elasticities.

Thus, when price controls are relaxed, the demand for imported cars decreases, not only because the controlled price increases but also, and numerically much more important, because domestic production increases. As discussed below, the market for imports is distorted. Any second-best effects in the market for imports that could arise from the change in import demand will be extremely small. This is because the price distortion does not change (the height of the triangle), so the change in import demand simply shifts the measured triangle of distortion costs toward the left without affecting its size.

In the case of cars, eliminating price controls in the model reduced imports from 61.6 thousand units to 30.7 thousand units. What subsidy rate to imports would be required to increase imports back to their original level if the price controls were not in effect? The answer is an estimate of 43 percent for cars and 22 percent for color televisions.[5] That is, without domestic price controls the government would have to pay 43 percent of the cost of imported cars to induce consumers to import as many cars as they would with price controls. With a smaller subsidy, consumers would import fewer cars than in the original 1988 situation after price controls are eliminated. Thus, although the government of Poland had no intention of subsidizing imported cars, the system of price controls was a very substantial implicit subsidy to imports. In the initial equilibrium, the data indicate that free-market cars sold for 2.8 times the controlled price, in comparison with a ratio of 2.0 for color televisions. Holding other things constant, freeing the price of domestic cars would lead to a greater expansion of domestic production and a greater substitution for imported cars. This in turn would require a greater import subsidy to induce an increase in imports to their original level.

Improved Foreign Exchange Policy

The second simulated policy change is an improvement in the exchange rate policy, with price controls remaining in place. The results are presented in table 2 and depicted in figure 3. The parallel market exchange rate (in March 1989 it was 2,900 zlotys to one U.S. dollar) was itself distorted (too high) because of the surrender requirements (at the official, grossly overvalued exchange rate) imposed on exporters for about 70 percent of their foreign exchange earnings. Tarr (1990c) has estimated the shadow foreign exchange rate at about 63 percent of the parallel market exchange rate (more than three times greater than the official exchange rate), where the parallel market exchange rate represented the cost of foreign exchange for individuals. The parallel exchange rate, which was quite volatile, depreciated by about 1,000 zlotys per U.S. dollar in April 1989. Exact estimation of a shadow exchange rate is, of course, problematical. The shadow exchange rate is clearly less than the parallel rate, however, and these estimates are illustrative of the impact of appreciating the parallel exchange rate toward

5. The policy is simulated by changing equation A-8 in the appendix to $u^*p^*(1 + t)$, removing price controls, and finding the value of u that yields imports in the original equilibrium. The implicit subsidy is then $1 - u$.

Table 2. *The Impact of Eliminating Macroeconomic Foreign Exchange Restrictions on the Automobile and Color Television Markets in Poland*

	1988 data		*Low elasticities*		*Medium elasticities*		*High elasticities*	
Item	*Cars*	*Televisions*	*Cars*	*Televisions*	*Cars*	*Televisions*	*Cars*	*Televisions*
Domestic controlled price, P_c	1.27	0.394	1.27	0.394	1.27	0.394	1.27	0.394
Domestic free price, P	3.54	0.788	3.09	0.705	3.00	0.634	2.96	0.602
Import price (tariff-inclusive), $p(1 + t)$	4.26	0.873	2.67	0.548	2.67	0.548	2.67	0.548
Domestic quantity, Q	177	294	177	294	177	294	177	294
Import quantity, q	61.6	156	77.8	197	98.2	249	156.6	397
Welfare gains								
Triangle of distortion	n.a.	n.a.	13	7	29	15	75	39
Rectangle of rent dissipation	n.a.	n.a.	0	24	0	45	0	55
Total	n.a.	n.a.	13	31	29	60	75	94
Welfare gains (percentage of)								
GDP	n.a.	n.a.	0.05	0.11	0.10	0.21	0.27	0.33
Domestic producers' sales	n.a.	n.a.	5.7	27.0	12.9	52.0	33.4	81.1
Domestic producers' sales plus imports	n.a.	n.a.	2.6	12.4	6.0	24.0	15.5	37.4

n.a. Not applicable.

Note: Prices are in millions of 1988 zlotys, quantities in thousands of cars or color televisions, welfare gains in billions of 1988 zlotys or as a percentage of 1988 estimated GDP.

Source: Author's calculations.

the shadow exchange rate. See Pinto (1991) for a model in which devaluation imposes a tradeoff in costs.

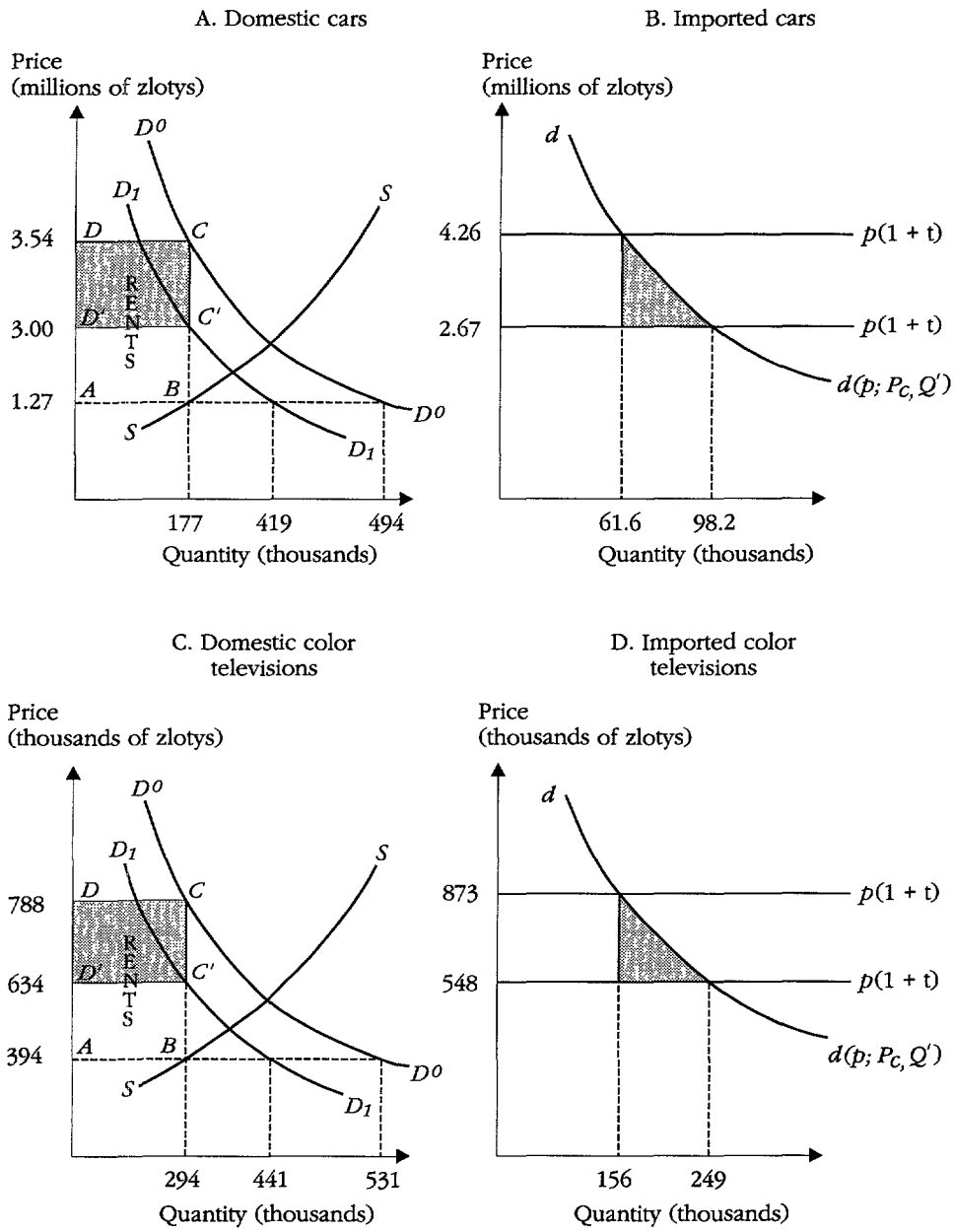
The opportunity costs of imports to Poland were more properly valued at the shadow exchange rate. At the parallel exchange rate, individuals were discouraged from consuming imported cars. If aggregate policies were changed (with a devaluation as occurred in 1990, or with a reduction in the surrender requirements of exporters), thus providing greater incentive to export and thereby inducing a lower exchange rate equal to the shadow exchange rate, individuals would import more, generating gains in consumption efficiency. The devaluation of 1990 encouraged a massive export boom during the first three quarters of 1990 until inflation (in significant part caused by the export boom with a fixed exchange rate) eliminated the highly favorable exchange rate for exporters (see the above-cited macroeconomic papers on Poland, especially, Pinto, Coricelli, and de la Calle 1990).

The gains from the improved foreign exchange policy estimated here are only the gains measured in the automobile and color television industries. Gains would also accrue throughout all importing industries in the economy. The estimates presented here, however, are illustrative of the magnitude of the likely gains from this policy in two important markets.

The decrease in the price of imports reduces the demand for domestic cars, because the goods are gross substitutes. The decrease in the demand for domestic cars results in a decrease in the price of cars on the free resale market for cars. Consequently, rents for domestic cars are reduced. There is no feedback effect on the price of imported cars, however, because under rationing of domestic cars the demand for imported cars depends on the market for domestic cars only through the controlled price in the domestic market and through the quantity of domestic cars produced (see equation A-3), neither of which changes. (Thus, the cross elasticity of demand for imports with respect to a change in the domestic price is not important for the welfare results.)

For both cars and televisions, the improved foreign exchange policy results in a triangle of benefits in the import market, which is shaded in panel B of figure 3. This is a traditional Harberger-type triangle, in which the marginal valuation of imports by consumers exceeds the marginal costs to society. In addition, the presence or lack of rent dissipation has a strong effect on the welfare results through second-best effects. Because import liberalization reduces the demand for the domestic substitute, it reduces the rent on domestic cars and color televisions to the smaller rectangle $ABC'D'$. Thus, the reduction in rents is equal to the rectangle $DD'C'C$. In color televisions the reduction in rents should reduce queuing time and therefore constitutes an additional benefit of import liberalization. This is a second-best type of benefit from the foreign exchange liberalization because it would not be a gain without the existence of the price control distortion in the domestic market. For cars, where I have argued that the rents are not dissipated, there is no second-best welfare effect in the domestic market.

Figure 3. *Impact of Eliminating Foreign Exchange Restraints on Cars and Color Televisions in Poland*



Note: Estimates are for the medium-elasticity case.
Source: Author's calculations.

In the central elasticity case, the second-best benefits of reduced rent dissipation in domestic color televisions (45 billion zlotys) are three times the direct distortion costs in the import market. Because there are no benefits from reduced rent dissipation in cars, the total benefits of foreign exchange liberalization in color televisions (0.21 percent of GDP) are about twice those of cars.

As the demand curve for imports becomes more elastic, it is evident from figure 3 that the triangle of estimated distortion costs in the import market increases. In addition, in the high-elasticity case, the cross elasticity of domestic demand with respect to a change in the price of imports increases. Then, in response to the decline in the price of imported cars, the demand for domestic cars on the free market shifts leftward in the high-elasticity case. This shift implies a greater reduction in rent and greater benefits from reduced rent dissipation. The triangle of distortion, however, becomes a larger share of the total benefits as elasticities increase, in part because the rectangle of reduced rent dissipation is limited by the finite amount of rent dissipation in the initial equilibrium. Based on the calibrated demand curve, excess demand for cars is 317,000 units initially and is reduced to 232,000 units after the import price is lowered (see figure 2).

IV. Conclusions

One important set of results in the article is that because the allocation method affects rent dissipation, the method of allocating the good under price control has a crucial impact on the welfare costs of the price control. For color televisions, where the allocation method leads to rent dissipation, the estimated welfare loss to the economy is about ten times the estimated standard distortion costs (based on Harberger triangles) when rent-seeking is ignored. The estimated welfare loss is more than 100 percent of the value of domestic producers' sales. By contrast, the evidence suggests that the allocation methods for cars did not result in rent-seeking costs.

A second set of results is that the price controls on domestic cars and color televisions increased demand for imported cars and color televisions and induced firms to produce fewer domestic cars and color televisions. Reduced domestic production of these products means that consumers who do not receive a domestic product must buy an import. This implies that the price controls on Polish domestic cars were an implicit subsidy to imported cars. The estimated rate of implicit subsidization (defined as the ad valorem rate of subsidy to imports necessary to increase imports to their original level if price controls were counterfactually removed) is 43 percent in cars and 22 percent in color televisions. Clearly, this was an unintended effect of the price controls and contrary to any desire of the government of Poland.

Given that the price control policies were generalized across most Polish industries in 1989, the macroeconomic implication is that Polish demand for foreign exchange was distorted upward, inducing a depreciation of the real

exchange rate on the free market. Tarr (1990c) examines the macroeconomic implications of this implicit subsidy to imports in a model that estimates optimal foreign exchange policy. Polish foreign exchange policy in 1989 discouraged exports through surrender requirements of foreign exchange at punitive rates. Reducing surrender requirements would improve welfare, but positive surrender requirements would be the optimal second-best policy in the presence of implicit import subsidies from price controls.

A third set of results is that with rent dissipation the costs of import restraints are considerably magnified in the presence of price controls on the domestic good. Constraining imports increases demand for the domestic price-controlled variety of the product; this will increase the rents of the domestic product and may increase wasteful rent-seeking activity. For color televisions, with dissipation of rents, the costs of import restraints are four times greater when the effect of the rent dissipation in the market for domestic cars is incorporated.

Taking into account the costs of rent-seeking, the welfare costs of price controls can be dramatically high; therefore, policymakers should be extremely cautious when using these devices. The estimates here have focused only on the static effects of price controls. Rent-seeking is also likely to produce reduced-growth effects as agents in the economy devote resources to petitioning their government rather than to innovation that develops new products or reduces costs.

Because rents may not be fully dissipated, to assess the quantitative importance of rent-seeking in particular markets requires the empirical investigation of allocation methods as well as estimation. In some situations in which policymakers must ration a good subject to a quantity constraint, such as the allocation of an export quota under the Multifibre Arrangement, devices that would avoid or reduce rent dissipation, such as auction quotas, have a significant argument in their favor.

Appendix: The Model of the Automobile and Color Television Markets in Poland

Differences in quality between Polish cars and imported cars, especially those from the West, are considered quite significant; a model that must take these products as differentiated is necessary. The model discussed here uses cars as the example. The alterations needed in the model for the case of color televisions are discussed later.

The essential feature of the Polish domestic automobile market in 1989 was that it was in shortage. Regardless of the price on the free resale market for domestic cars, aggregate production, and consequently consumption, of domestic cars was fixed (unless the official price changed). Within the range of the relevant policy experiments to be considered, whatever was produced and offered at the official controlled price (denoted by P_c) would be purchased by domestic consumers.

Let there be three goods: domestic cars (Q), imported cars (q) and a composite of other goods (X). Assume that the preferences of different consumers can be aggregated such that they may be represented by a single utility function.[6] Then maximize utility $u(Q, q, X)$, subject to income and prices.

Let Q' denote the fixed amount of domestic cars produced and purchased by consumers. There is a resale market for domestic cars, which clears, but sales on this market do not affect the quantity of domestic cars consumed, which is fixed at Q'. Because sales on the resale market only represent income transfers among consumers, they do not affect total income available to all consumers for purchase of the other goods, q or X. Thus, for the purpose of deriving the aggregate demand function for car imports, the resale market may be ignored. Consumers consume the fixed number of units Q', for which they pay P_c per unit, and the maximization problem is reduced to

$$\text{(A-1)} \qquad \max u(Q', q, X) \qquad \text{subject to } Y = P_c Q' + p'q + P_x X$$

where Y denotes income, P_x denotes the price of X, and p' denotes the tariff-inclusive price of q.

Define utility, U, as a function of q and X, with Q' as a parameter: $U(q, X; Q') = u(Q', q, X)$ and $Y' = Y - P_c Q'$, where Y' is residual income available for purchase of q and X after Q' is purchased at the controlled price.

Then the utility maximization problem may be further reduced to

$$\text{(A-2)} \qquad \max U(q, X; Q') \qquad \text{subject to } Y' = p'q + P_x X.$$

From equation A-2, maximization of U subject to Y' yields the following market demand function for q:

$$\text{(A-3)} \qquad q = d[p', P_x; Y'(P_c Q'), Q'].$$

Equation A-3 explicitly incorporates the parameters on which residual income depends. Note that the demand function depends on both P_c and the additional parameter Q'. Both P_c and Q' have an effect on the demand for q through their impact on Y'. In addition, because the utility function depends on the additional parameter Q', it is included separately as a parameter.[7]

Define the free-market price of domestic cars on the resale market as P. Note that P is not included in the demand function for imported cars because P has no effect on the amount of domestic cars consumed as a result of the shortage. In other words, there is no substitution effect. A change in P has a redistributive

6. The necessary and sufficient condition for this aggregation is that the indirect utility of all consumers satisfy the "Gorman form." That is, the indirect utility of all individual consumers (v_i) satisfies

$$v_i(\mathbf{p}, y_i) = a_i(\mathbf{p}) + b(\mathbf{p})\, y_i$$

where i is an index over consumers, y is income, and $\mathbf{p}$ is the price vector (see Varian 1984: 150–53). This implies, in particular, that the marginal propensity to consume any good with respect to income is independent of both the level of income and of the consumer.

7. Equation A-3 is analogous to equation 11 in Neary and Roberts (1980), except that the demand function for the unconstrained good in Neary and Roberts is compensated (Hicksian).

effect among consumers but does not affect the aggregate residual income of all consumers available for the purchase of q or X, that is, the change in the free-market price has no aggregate income effect.

The aggregate quantity demanded of domestic cars (Q'), imported cars (from equation A-3), and the composite good (an equation of the same form as equation A-3) can be completely characterized without reference to the free-market price, P. This result derives from the aggregation of the demand functions of different consumers and the fact that the economy consumes the allocated number of cars.

The case of color televisions is more complicated because of the assumption that the rents are dissipated through queuing. That is, the difference between the free-market price and the controlled price is the value of foregone leisure. The full price to the consumer-worker (which is equal to the controlled price plus the wage rate times the waiting time) is the relevant price for determining the demand curve. As shown below, however, the full price in equilibrium depends on the fixed quantity Q' and the controlled price; so the demand function for imported color televisions is written with P_c and Q' as parameters.

The Demand Function for Domestic Cars

To simulate the impact of removing price controls, it is necessary to know the Marshallian market demand curve for domestic cars. Suppose there is no price control and the quantity of domestic cars available to consumers is a variable over which they may optimize. Assuming that the preferences of individual consumers may be aggregated, and denoting aggregate income by Y, the form of the aggregate Marshallian demand function for domestic cars is standard:

$$Q = D(P, p', P_x; Y). \tag{A-4}$$

Fortunately, from the resale open-air market for domestic cars, observations are available for the price of domestic cars that clears the resale market. That is, an observation of a point on equation A-4 is available because the free-market price is the price at which the Marshallian demand curve clears for the number of cars produced, given other parameters in the economy affecting demand (including the supply of used cars and the extent of their substitution with new cars). These observations allow us to avoid the indirect methods sometimes used to infer such a point, such as virtual prices in Neary and Roberts (1980) or inventory models.

With the demand curve given by equation A-4, the new equilibrium prices and welfare effects in the event of price decontrol can be determined. In addition, it will be possible to determine the value to consumers of additional units of Q deriving from an easing or termination of domestic price controls; to assess the rent transfers among consumers; and to compute excess demand directly.

Equations of the Simulation Model

To simulate the model, it is necessary to specify a specific functional form. One method would be to choose a specific form of the utility function and derive the

demand functions. Instead, I specify the "linear in the logs" form because of the convenient interpretation of the coefficients as elasticities and because it is robust (for large changes in the variables) regarding the existence of a solution. The right-hand variables in the import demand function are those derived from the above theory. Thus, the specification is analogous to an econometrician's use of reduced-form equations where the theory is employed to determine the relevant variables and, in this case, to assist with the specification of the elasticities.

Two concerns may arise in determining how the lack of a direct correspondence between the theory and the simulation model affects the measurement of welfare. One concern might be that because the simulation model does not follow directly from the choice of a specific utility function, a "consumers' surplus" measure of change in welfare must be employed, as opposed to an "exact" welfare measure such as Hicksian equivalent or compensating variation. Willig (1976) has shown, however, that consumers' surplus is bounded from above and below by equivalent and compensating variation; and his numerical results and those of de Melo and Tarr (1992) have shown that estimates of compensating and equivalent variation are generally close. Thus, estimates of consumers' surplus will be close to estimates of both compensating and equivalent variation. To the extent that estimates of consumers' surplus depart from one Hicksian measure, they will be close to the other Hicksian measure, and there is no a priori reason to believe one Hicksian measure is superior to the other.

A second concern could be that the wrong rectangles and triangles are being measured. Specification of a specific utility function could give rise to a demand function different from the one pictured in figure 1. But any demand function chosen would have to be calibrated to be consistent with both the initial data point and the exogenously specified elasticities. The rent rectangle is completely independent of the functional form because the demand function must pass through the initial data point. Regarding the triangle, the first-order effect on determination of its size is the slope of the demand curve at the initial data point. The initial slope of the demand curve is also unaffected by choice of functional form, because any functional form for the demand function must be calibrated to the exogenously specified elasticity. Alternate specifications to the log log would yield different measurements of the triangle if the alternate specifications were not constant elasticity; but these would be smaller second-order effects. In addition, these differences would not be based on any known data, but rather on the arbitrary assumption of a particular functional form.

I invoke a standard assumption in applied microeconomic modeling and assume that utility is weakly separable between aggregate automobile consumption and the composite good, X. This implies that the demand functions for domestic and imported cars may be formulated without explicit reference to the price of the composite good, X. The price of the composite good will affect demand for cars only through its impact on the income allocated to aggregate automobile consumption.

The simulation model is partial equilibrium. Consequently, I ignore the effects of changes in income and other variables outside the automobile sector on the variables of the model. These other variables are incorporated into the constant of the demand function. The model is characterized by equations A-5 through A-8.

$$\ln(q) = a + b\ln(P_c) + c\ln[p(1+t)] + s\ln(Q) \tag{A-5}$$

$$\ln(Q) = A + B\ln(P) + C\ln[p(1+t)] \tag{A-6}$$

$$P_c = P_c' \tag{A-6'}$$

$$\ln(Q) = D + E\ln(P_c) \tag{A-7}$$

$$p(1+t) = \mathrm{k} \tag{A-8}$$

where k is a constant and t is the tariff rate, so that $p(1+t) = p'$(where p′ was defined above) is the tariff-exclusive price of imported cars.

Equations A-5 and A-6 are the demand functions for imported and domestic cars, respectively. Equation A-6′ states that the controlled price is fixed at P_c', which applies in the experiment in which price controls are maintained and the import regime is liberalized. When price controls are removed, equation A-6 replaces equation A-6′. Equation A-6 is also used when price controls are in place to estimate the value of the rent from receiving an allocated car and the amount of excess demand.

Equation A-7 is the supply function for domestic cars. Despite the fact that there were only two Polish automobile producers, I have chosen to ignore monopoly power issues on the supply side of the market and to model the industry as competitive. The reason is that import competition from many countries was present in Poland. In the case of cars, Romanian, Czechoslovakian, and Russian cars were of comparable quality and would be expected to restrain price increases if the price controls were removed. In addition, used cars from Western Europe (which became very popular in Poland after the Big Bang) represented another constraint on price increases of domestic cars beyond competitive levels. In the case of color televisions, imports from Russia, the Republic of Korea, and Taiwan (China) (among other economies) offered significant competition.

Automobile producers are assumed to face increasing marginal costs of production. To increase production would require more labor, for example. To attract additional workers to an automobile company requires paying higher wages because there is little unemployment in Poland. Increasing marginal costs implies that the supply curve is upward sloping, and the supply curve depends on the price received by the firms, which is the controlled or official price.[8] In addition, Poland is an economy facing generalized shortages. As a result, some

8. Either profit maximization or cost-plus-markup pricing rules lead to an upward-sloping supply curve, given increasing marginal costs.

inputs into automobile production will be fixed or close to fixed. It follows from the Le Chatelier principle (see Varian 1984: 56, 57) that the more inputs are in fixed supply, the more inelastic is the supply curve of the firm. Thus, I assume a very low elasticity of supply by Western standards and simulate the results over a range of elasticities.

In equation A-8, I adopt the small country assumption and assume that imports of cars are supplied to Poland at a delivered price, in dollars, that Poland cannot influence. Poland does, however, have the ability to impose tariffs and influence its exchange rate so the price to consumers of imported cars in zlotys can be altered.

Elasticities

I have made an effort to search for econometrically estimated elasticities relevant to the color television and automobile industries in Poland. The elasticities chosen are more in the nature of best guesses rather than precise estimates. As is commonly done in applied welfare analysis, sensitivity analysis is performed by doubling and halving all elasticities.

Own Elasticities. In the case of cars, estimates of the own price and income elasticities are obtained from the econometric study of the Polish automobile market by Charemza, Gronicki, and Quandt (1988). Their broad conclusion is that the price elasticities of demand are high (usually greater than unity) but the income elasticity is low. Thus, in the central elasticity case, the own elasticities (B and c) are set at -1 and the income elasticity at 0.5.

In the case of color televisions, in the central elasticity case, the own price elasticities are -0.855, based on the estimates of Shiells, Stern, and Deardorff (1986). From the same source, the income elasticity is 1.65. Because of generalized input shortages prevalent in Poland in 1989 (as discussed in the text), the supply elasticity (E) is taken to be a rather low 0.5 in the central elasticity case for both cars and color televisions.

Cross Elasticities in the Demand for Imported Cars. The appropriate values for the cross elasticities of equation A-5 can be obtained from equation A-3. First consider the elasticity of demand for imported cars with respect to a change in the controlled price of domestic cars. Taking partial derivatives from equation A-3,

$$\frac{\partial q}{\partial P_c} = \frac{\partial q}{\partial Y'} \frac{\partial Y'}{\partial P_c}.$$

From the definition of Y'

$$\frac{\partial Y'}{\partial P_c} = -Q'.$$

Thus b, from equation A-5, can be expressed as

$$b = \frac{P_c}{q} \frac{\partial q}{\partial P_c} = \frac{P_c}{q} \frac{\partial q}{\partial Y'} (-Q').$$

Define the income elasticity of imported cars as

$$e = \frac{\partial q}{\partial Y'} \frac{Y'}{q}.$$

Rearranging yields

$$b = \frac{-P_c Q'}{Y'} e = (-S_Q) e$$

where $S_Q = P_c Q'/Y'$ is the share of residual income spent on domestic cars. That is, the cross elasticity of import demand with respect to the price of domestic cars reduces to the share of residual income spent on domestic cars times the income elasticity of demand for imported cars. Given $e = 0.5$ (1.65 in color televisions) from above, and given data on S_Q, $b = -0.008$ in cars and -0.004 in color televisions.

Note that, although small, the value of b is negative. This contrasts sharply with equilibrium models. Here the increase in the controlled price of domestic cars does not induce a decrease in domestic quantity demanded, so there is no substitution effect. There is only an income effect of the domestic price increase, which reduces demand for all normal goods, including imported cars.

Now consider s, the elasticity of demand for imported cars with respect to the quantity of domestic cars. Differentiate equation A-3 with respect to a change in the amount of domestic cars allocated. The change in demand for imported cars is

$$\text{(A-9)} \qquad \frac{\partial q}{\partial Q'} = \frac{\partial q}{\partial Y'} \frac{\partial Y'}{\partial Q'} + \frac{\partial q}{\partial Q'}$$

(with residual income, Y', constant). The change in the demand for imported cars when the quantity of domestic cars changes is decomposed in equation A-9 into two components. The first component is the income effect on purchases of imported cars when an additional unit of domestic cars becomes available. The second component is the substitution effect. This equation is analogous to the Slutsky equation and to equation 21 in Neary and Roberts (1980). Because $\partial Y'/\partial Q' = -P_c$, the first term on the right side of equation A-9 is

$$\frac{\partial q}{\partial Y'} \frac{\partial Y'}{\partial Q'} = \frac{\partial q}{\partial Y'} (-P_c).$$

Now consider the second term, $\partial q/\partial Q'$ in equation A-9. If the goods are perfect substitutes, then a one-unit increase in the quantity of domestic cars available would, absent income effects, decrease the purchase of imported cars by exactly one unit. That is, $\partial q/\partial Q' = -1$. If the goods are not perfect substitutes, a one-unit increase in domestic cars will induce a decrease of less than one unit in imported cars. The decrease, for example $-v$, where $0 < v < 1$, is a product-differentiation parameter, where smaller values imply that the goods are less perfect substitutes. Here v is assumed to take the value 0.7.

Combining these results yields

$$\frac{\partial q}{\partial Q'} = \frac{\partial q}{\partial Y'} (-P_c) - v.$$

Multiplying both sides by Q'/q and the first term by one in the form of qY'/qY', yields the elasticity s:

$$s = \frac{Q'}{q} \frac{\partial q}{\partial Q'} = -S_Q e - \frac{vQ'}{q}.$$

The first term on the right-hand side, $-S_Q e$, has been calibrated above. (It is the income effect of the change in quantity, and it affects residual income in a symmetric manner to the price of domestic cars.) Given $v = 0.7$ and data on Q'/q, the second term $v\,Q'/q$ numerically dominates the first, and so $s = -2.0$ in the case of cars and -1.32 in the case of color televisions. Thus, in the simulation of decontrol of domestic prices, the demand for imports decreases; this is because the increase in the demand for imports, caused by the increase in P_c, is considerably less than the decrease in the demand for imports caused by the increase in Q'.

The Cross Elasticity in the Demand for Domestic Cars. Finally, the value C is the cross elasticity of demand for domestic cars with respect to the price of imported cars. As mentioned above, I assume the consumer's utility function for cars (imported and domestic) is "weakly separable" from all other goods. Given weakly separable utility, it is possible to derive the following:

$$S_{Q'}C + (S_q)c + S_q = \frac{\partial Y_A}{\partial p'} \frac{p'}{Y_A} \tag{A-10}$$

where $S_q = p'q/Y_A$ and $S_{Q'} = PQ'/Y_A$ and Y_A denotes income allocated to cars, and C and c are from equations A-5 and A-6. This relationship follows from a result in Tarr (1990a) for the share-weighted sum of own and cross elasticities within a branch of a utility tree.

The shares are known data, and I have an estimate of the own elasticity of demand. The term on the right of equation A-10 is the elasticity of demand of income allocated to aggregate automobile consumption with respect to a change in the price of imported cars. It is reasonable to assume that a change in the price of imported cars has only a small impact on the income allocated to cars; I take this value to be 0.25. Solving equation A-10, C = 0.35 in the case of cars and C = 0.40 for color televisions.

Calibration and Sensitivity

The model was calibrated to 1988 data. All the parameters in equations A-5 through A-8 are known except a, A, and D. Thus, data are available for the values of Q, q, P, P_c, and $p(1 + t)$ for 1988 (these data are presented in table 1). I assume that these values are a solution to the system of equations A-5 through

A-8.[9] The above values of the elasticities are used to solve for the constants A, D, and a. Note that the observed values of Q and P in 1988 are on the demand curve given by equation A-6, but there is a shortage in the market for domestic cars at the controlled price.

To assess the sensitivity of the estimates to the elasticities, I choose high- and low-elasticity estimates by doubling and halving all elasticity values. The constants a, A, and D are recalibrated and the policies are resimulated.

The Choice between Labor and Leisure and the Demand for Price-Controlled Commodities with Queuing

I extend the model of Abbott and Ashenfelter (1976) to justify writing the demand for imports as a function of Q' and P_c.

Assume that the consumer-worker must allocate income and time. Let $q_i, i = 1, \ldots, n$ represent commodities; q_0 represent leisure; and $\mathbf{q}$ be the vector of $n + 1$ commodities plus leisure. Let one of the commodities, say q_1, be subject to a price control. To obtain each unit of q_1, the consumer must pay the controlled price P_c plus e units of time in the queue. Let w denote the wage rate. Income available to the consumer-worker is $wL + \mu$, where L denotes hours worked, μ denotes nonlabor income, and the total time available to the consumer-worker is T, where $T = q_0 + L + eq_1$. Because the opportunity cost of time is w, the full cost to the consumer of one unit of q_1 is $p_1 = P_c + we$.

Money expenditure must satisfy

$$P_c q_1 + \sum_{i=2}^{n} p_i q_i = wL + \mu.$$

Add $wq_0 + weq_1$ to both sides to obtain

$$\text{(A-11)} \qquad \sum_{i=0}^{n} p_i q_i = wT + \mu = X$$

where $p_1 = P_c + we$, $p_0 = w$, and $T = q_0 + L + e\,q_1$; the latter substitution guarantees that the consumer-worker satisfies the time constraint that includes queuing time. Define the right-hand side as "full income," X.

Note that because X is fixed, the consumer-worker-queuing problem can be converted into the standard form of consumer utility maximization. That is, the consumer-worker will seek to

$$\text{(A-12)} \qquad \max u(q) \text{ subject to } \sum_{i=0}^{n} p_i q_i = X.$$

Maximization yields the standard condition that the marginal rate of substitution is equal to the ratio of prices:

$$\text{(A-13)} \qquad \frac{u_i}{u_j} = \frac{P_i}{P_j} \qquad \forall\, i, j$$

9. The details regarding the data sources are described in appendix B of Tarr (1991). The reader may request this paper through Internet by sending an electronic message to MPATENA@WORLDBANK.ORG.

and demand functions will depend on the vector of $n + 1$ prices and full income. Because $p_1 = P_c + we$, it is evident that the market demand for q_1 and close substitutes are a function of P_c.

Although the individual consumer-worker takes the wait in the queue as a given parameter, e, for the market as a whole e is a decreasing function of Q', the quantity available on the market. Thus, if Q' increases, the quantity demanded of q_1 will increase and the quantity demanded of close substitutes will decrease; that is, the quantity available of the price-controlled commodity is a parameter of the market demand curve for q_1 and for its close substitutes. This justifies writing the demand curve for imports as a function of both P_c and Q'.

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