Measuring Corruption under China's Dual-Track System

Wei Li[1]
Darden Graduate School of Business Administration
University of Virginia
Box 6650
Charlottesville, VA 22906-6650
Email: WeiLi@virginia.edu
Tel: (434) 243-7691
Fax: (434) 243-7681

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Abstract

In this paper, I present statistical evidence of the pervasiveness of official diversion in China's industrial planning bureaucracy under the dual-track system. The underpricing of in-plan goods and the ensuing shortage in the plan led to gains from trade between officials who controlled the allocation of in-plan goods and customers willing to pay more than the plan prices. By diverting goods from the plan and reselling them at higher market prices, this corruption creates leaks in the plan. Using data from a survey of state-owned manufacturers supplemented by aggregate input-output data, I find that the leakage in the plan, which measures the size of official diversion, became statistically detectable after the introduction of the dual-track system in 1985 and increased sharply in the late 1980's. Estimates show that approximately one-third of all in-plan industrial output was diverted between 1987 and 1989.

1 Introduction

Being illicit, corruption is inherently difficult to measure. Until recently anecdotal collections of individual cases of corruption had been the main sources of data for research, observed Della Porta and Rose-Ackerman (2002). The 1990's saw a burgeoning literature on corruption that relies on survey-based, subjective measures of corruption.[1] This literature helped shed considerable light on the determinants and consequences of corruption. But the use of subjective measures of corruption raises concerns of perception biases.[2]

More recently, a few authors documented evidence of corruption by testing its behaviorial implications at either the firm or individual level. Duggan and Levitt (2000) studied the effects of match rigging in Japanese sumo wrestling. They documented that the rule of promotion in the game gives a wrestler on the margin for achieving a winning record strong incentives to bribe his opponent to fix the match, and found that wrestlers on the margin won a disproportionate share of the matches. Fisman (2000) documented that Indonesian firms with close ties to former President Suharto, who reputedly ran a corrupt regime, had steeper declines in stock prices than other Indonesian firms on news of Suharto's weakened health. Di Tella and Schargrodsky (2003) found that procurement prices for basic inputs in public hospitals in Buenos Aires fell significantly after a corruption crackdown. In Li (2002a), I studied *guandao* or official diversion under the dual-track system—a form of corruption in the industrial planning bureaucracy where corrupt officials obtained goods at low plan prices and resold them at high market prices. I found evidence that officials increased plan procurement for the purpose of diversion when the gap between market and plan prices widened. These studies made creative use of microeconomic data to objectively document indirect evidence of corruption by analyzing its effects. But they could not quantify the scale of corrupt exchanges.

In this paper, I attempt to go one-step further by measuring the scale of official diversion under the dual-track system in China. The dual-track system, introduced in 1985,[3] was a

[1] Studies that use cross-country indexes of corruption perception include Mauro (1995), Hines Jr. (1995), Alesina and Weder (1999), Ades and Di Tella (1999), La Porta, Lopez-de-Silanes, Shleifer and Vishny (1999), Wei (2000), and Treisman (2000) among others. Studies that use disaggregated corruption data based on reported grafts by businesses include Svensson (2003).

[2] See Della Porta and Rose-Ackerman (2002) for more discussion.

[3] Before its introduction in 1985, resource allocation in China was done mostly under the plan via the planning bureaucracy. Shortages were pervasive and most goods were rationed. Starting in 1978, the Chinese government began to relax the plan by encouraging state-owned firms to produce more than their compulsory

hybrid economic system under which traditional central planning (the plan track) and the emerging product market (the market track) coexisted as a means of resource allocation. On the plan track, officials at the Material Supply Bureaus (MSB) procured goods at plan prices from state-owned firms via compulsory output quotas and were supposed to allocate the procured in-plan goods to various in-plan uses also at plan prices. On the market track, both state and non-state firms were allowed to sell their outside-plan outputs at market clearing prices. Under the dual-track system, an identical good was typically sold at a substantially higher price in the market than in the plan, necessitating rationing on the plan track. As a key component in China's gradualist transition strategy, the dual-track system has been widely considered an important factor contributing to China's relatively smooth transition to a market economy (Li, 1999; Lau, Qian and Roland, 2000). Nevertheless, many observers believed that the system created a fertile environment for official diversion.[4] There existed ample anecdotal evidence that official diversion was common under the dual-track system.[5]

That the dual-track system was a hotbed of corruption is hardly surprising. There was in the system a strong incentive for official diversion. Table 1 presents some statistics that document the functioning of the dual track system based on data from a survey of state-owned manufacturing firms.[6] After the liberalization of outside-plan prices on January 1, 1985, market prices exceeded plan prices for both output and inputs by a wide margin (Columns 1 and 4). The gap grew substantially in the late 1980's as plan prices did not keep up with inflation.[7] The right to procure goods at plan prices became increasing valuable. Columns 3 and 6 show that officials procured an increasing amount of goods from state-

quotas and to sell their outside-plan outputs at higher "floating prices." These "floating prices" were not free-market prices, however. Regulation enforced by the State Price Bureau limited these prices to be no higher than 20% of their corresponding plan prices. On January 1, 1985, the government lifted the price control on outside-plan transactions and officially ushered in the dual-track system.

[4]In a heated policy debate in the late 1980's in China, opponents of the dual-track system, citing the system's association with pervasive official corruption, argued for its speedy demise. Most proponents of the system did not dismiss this association but thought that its benefits exceeded the costs. See, for example, Zhi Muxing and Gai Shi, "To Where is the Dual-Track System Leading China?" *Economics Weekly* (in Chinese), March 26, 1989.

[5]Despite tight government control over the media, many cases of official diversion did get published. For instance, the *Sichuan Daily* reported on January 10, 1988 that 15 officials in Sichuan province were tried for diverting 261 cars. On December 21, 1988, the *Hunan Daily* reported that local officials pocketed a profit of 160,000 yuan from illegally selling 1,293 tons of in-plan chemical fertilizers at the market price.

[6]A brief description of the enterprise survey data is given in Section 3.2.

[7]The State Price Bureau froze plan prices for most industrial goods in October 1988 in an attempt to contain inflation (Yang and Li, 1993, p. 57).

owned firms at plan prices, but delivered a decreasing amount of intermediate inputs at plan prices. The data thus imply that each sample firm's net material contribution to the plan (Column 3 minus Column 6) increased from 16.2 to 30.1 million yuan (valued at 1989 market prices) per firm between 1981 and 1989, with most of the increases realized after 1985. In 1989, corrupt officials could pocket a profit of 12.4 million yuan (or $.39 \times 44.2/1.39$) by diverting an average sample firm's in-plan procurement. Compared to the salary of a high ranking official, which rarely exceeded 10,000 yuan, the temptation was hard to resist.

The dual-track system not only provided a fertile environment for official diversion, it also transformed this corruption. In Section 2, I describe how official diversion evolved from one that relied on under-the-table barter exchanges under central planning to one that relied in part on market exchanges under the dual-track system. By monetizing and marketizing corrupt exchanges, the dual-track system reduced the transaction costs of official diversion and helped it to become increasingly pervasive, culminating in 1989 to the massive demonstration on Tiananmen Square in Beijing. It also helped make official diversion statistically observable. When corrupt officials diverted goods from the plan and sold them on the market, they decreased the allocation of goods to in-plan uses for any given level of in-plan procurement, creating "leaks" in the plan. The leakage is thus equal to the gap between what were procured into the plan (in-plan sources) and what were put to in-plan uses. Since the allocation of goods in the plan should satisfy the condition of material balance in the absence of official diversion, the leakage measures the volume of official diversion.

In Section 3, I estimate the leakage in the plan using data from a survey of Chinese state-owned manufacturers supplemented by China's 1987 input-output table. My estimation shows that the leakage became statistically detectable after the introduction of the dual-track system in 1985 and it increased sharply in the late 1980's. Between 1987 and 1989, approximately one-third of all in-plan output was diverted on average. Given the large price differential between market and plan prices shown in Table 1, the proceeds or rents from official diversion were staggering. Estimates of the proceeds per sample firm between 1987 and 1989 are equal to over 40% of industrial value-added and 65% of the profits of an average sample firm. A back-of-the-envelop estimation shows that the rents from diversion in China's industrial planning bureaucracy amounted to about 10% of GDP between 1987 and 1989.

My empirical analysis thus provides strong statistical evidence that official diversion in China's industrial planning bureaucracy not only existed, but was highly pervasive under

the dual-track system. Based on these findings, I offer some concluding remarks in Section 4.

2 Official Diversion

Contrary to popular belief,[8] diversion of in-plan resources for private gain existed before the introduction of the dual-track system.[9] But it took a different form and was likely less pervasive than in the 1980's. Before the reforms, most goods and services were under-priced and rationed. Monetary payments alone were insufficient to purchase goods and services. There thus existed gains from trade between officials who controlled the ration permits and those who were willing to offer in-kind bribes in addition to paying the low plan prices. For example, an official who controlled the allocation of steel could allocate one ton of in-plan steel to a bicycle factory at the nominal plan price in exchange for ration permits that would allow him or his work unit to purchase five bicycles at the plan price.[10] Neither party would have the incentive to reveal this illicit *quid pro quo*. The official record would show two unrelated in-plan transactions: 1) the official allocated one ton of in-plan steel to the bicycle factory, and 2) the factory sold five bicycles to consumers with ration permits.

Such corrupt barter exchanges were facilitated by the existence of *guanxi wang* or connection networks, which formed an informal economy. To gain access to a network or to establish *guanxi*, an official had to be willing to trade what he controlled and to build personal ties with other members of the network. Having *guanxi* was valuable since it enabled one to have *houmen* or back-door access to shortage goods and services.[11] The prevalence of *guanxi* in the pre-reform China suggests that corruption was not uncommon then.

But why was public perception about corruption so much lower before 1985? One reason

[8] Demonstrators at Tiananmen Square in 1989 were reportedly nostalgic for the pre-reform days when the government was perceived as "clean" (*Wall Street Journal*, May 19, 1989).

[9] This observation isn't new. Chinese journalist, Liu Binyan (1979) exposed corruption in the 1970's in his influential reportage, "*Ren Yao Zhijian* (Between Man and Demon)." Kwong (1997) studied the "socialist mode of corruption" in China between 1949 and 1989.

[10] Corrupt officials in general gained personally from diversion. But they might also engage in diversion in the interests of their organizations, often sharing the rents with employees in their organizations. Kwong (1997) names this kind of diversion organizational corruption. Both personal and organizational types of official diversion involve the misuse of official positions for private gains at the expense of the state. Both are included in the analysis in this paper.

[11] Chang (1991, p. 456) described how her father, an incorruptible man in the pre-refrom China, refused to use his *guanxi* to secure her admission to Sichuan University. To use his *guanxi* would have meant being indebted to the admissions officials. But thanks to her mother, who paid a visit to the wife of the head of the admissions committee, presumably to arrange a *quid pro quo*, she enrolled in Sichuan University in 1973.

may be that high transaction costs in arranging barter exchanges naturally limited the scale of corruption. Even the most reprehensible corruption scandal in the pre-reform years would have been considered a small time crime in the late 1980's.[12] But a more important reason is that corrupt barter exchanges, like the steel-for-bicycles example above, were hidden. Official records contained little information on corruption.

The introduction of the dual-track system in 1985 transformed official diversion. As product markets developed, goods became available at market clearing prices. Money emerged as a medium of exchange. Official diversion, once carried out through cumbersome barter exchanges, was increasingly marketized and monetized, as perpetrators started selling diverted goods on the market for cash. Cash proceeds from diversion could be saved in anonymous bank accounts in China or be spent on goods and services that became available on the market. The monetization and marketization of official diversion implied that this corruption could be carried out at much reduced transaction costs. By straddling both the plan track and the market track, a perpetrator of official diversion was no longer a barter trader but an active arbitrageur buying low from the plan and selling high on the market. An immediate implication of this transformation is that official diversion should have become much more pervasive in the late 1980's. Another implication is that official diversion should in theory have become more visible since market exchanges were in principle more transparent than barter exchanges. For one, the implied bribe per unit of a diverted good, once an unknown to outsiders, could now be calculated as the difference between market and plan prices. But the fact that very few corrupt officials were caught suggests that official diversion remained largely hidden. How did corrupt officials manage to conceal marketized corrupt exchanges?

Based on Chinese journalists' accounts,[13] the operation of official diversion often involved the use of a network of trading companies, otherwise known as *pibao gongshi* or briefcase companies.[14] Figure 1 illustrates a stylized example that traces the diversion of 40 tons of

[12]The corruption scandal documented in stark vividness in Liu's (1979) reportage, while shocking to an average Chinese in 1979, was rather small in scale. The primary perpetrator, Wang Shaoxin, a local official in Heilongjiang province, diverted and hoarded agricultural goods that were in short supply. Her crime included giving in-kind bribes of 4,350 kg of meat, 59 pigs, 3,800 cartons of cigarettes, 4,450 kg of fish, and 8,400 bottles of liqueur.

[13]See for example Huang and Li (1991) and Huang (1996).

[14]These companies were so named because their tangible assets (*e.g.*, business cards and company seals) could easily fit into a briefcase. Their most valuable assets were of course intangibles—strong ties to the planning bureaucracy. There is evidence (Huang, 1996, p. 177) that briefcase companies existed in large

in-plan steel via four briefcase companies. Created and controlled by a close-knit network of officials, these companies were often licensed to resell in-plan goods for a small, government-approved markup (5% in Figure 1) to cover "administrative and marketing expenses." Through repeated reselling of diverted goods among a network of briefcase companies,[15] the officials could capture the diversion rents in the form of administrative and marketing fees on each transaction. With a sufficiently long chain of transactions, the officials could raise the price of the in-plan good to its market clearing level before offloading it to users at the market price.[16] In essence, corrupt officials used briefcase companies to launder in-plan goods into market goods via a series of apparently legal transactions.

In this stylized official diversion, the briefcase companies together with the MSBs formed an alternative distribution network, linking producers of in-plan goods with buyers of the diverted goods on the market track. They also functioned as a safety buffer separating the corrupt officials and the buyers who paid market price for diverted goods. By interfacing only with the briefcase companies that they controlled, corrupt officials could divert in-plan goods with near impunity. To see why, consider the MSB's sources and uses of in-plan steel on its material balance account in Figure 1. The MSB procured 80 tons of steel from the steel plant (sources of in-plan steel). It then distributed 40 tons to the bicycle plant and 20 tons each to two in-plan resellers (uses of in-plan steel). By recording the sales to the two briefcase resellers as in-plan, the MSB kept its in-plan material balance account in balance. The official diversion could not be detected by auditing the MSB's account,[17] or by auditing each individual briefcase company's account.

But a joint analysis of the accounts of the steel plant (the producer) and the bicycle plant (the user) is more revealing. While the steel plant delivered 80 tons of steel into the plan, the bicycle plant received only 40 tons at the plan price and had to pay market price for the remaining 40 tons. Cross examination of data from both the producer and the user

numbers. In 1985, there were 328,893 registered companies. A government crackdown on briefcase companies in 1986 reduced the number of registered companies down to 173,000 by the end of 1986, apparently without much disruption to economic activities. Between 1987 and 1989, during which official diversion was considered particularly pervasive, the number of registered companies rose sharply to 477,400. The *People's Daily* reported on August 30, 1988 that 47,900 cadres in China were involved in running "companies."

[15] A more common practice was to resell ration permits that gave their holder the right to purchase the diverted goods at plan prices.

[16] In one case the price of a shipment of steel plates rose from 1750 yuan per ton to 4,600 yuan after 129 paper transaction (the *People's Daily*, June 22, 1988; cited in Gong (1994, p.137)).

[17] This is confirmed by data. Analyzing aggregate MSB accounts,Li (2002b) did not find any significant discrepancy between the sources and uses of in-plan steel and other commodities between 1986 and 1990.

thus reveals that 40 tons of steel was diverted from the plan.

This observation suggests that one way to detect and measure the diversion traffic is to examine the material balance accounts of the producers and the users. As diversion moves in-plan goods to the market track, producers will necessarily sell more goods into the plan and less to the market, while users will receive less from the plan and will have to buy more from the market. A significant leakage in the plan then measures the size of official diversion. In the next section, I use this insight to measure official diversion.

3 Testing and Measuring Official Diversion

3.1 Testable implications

In the absence of diversion, resources should flow separately on the plan track and the market track. Goods procured into the plan, if not diverted to the market, should be distributed only to in-plan uses. Similarly, in-plan intermediate goods, if not diverted to the market, should be used to produce only in-plan goods. In the absence of any leakage from the plan, the flow of resources on the plan track in any given year should balance.

Consider first the material balance in in-plan distribution. The no-diversion condition implies that the value (measured in plan prices) of output procured into the plan from firm i, Q_{it}, should equal the sum of all in-plan purchases for that output from industrial intermediate users, non-industrial intermediate users and final users,[18]

$$Q_{it} = \sum_k X^I_{ikt} + \sum_n X^N_{int} + F^Q_{it}, \tag{1}$$

where X^I_{ikt} and X^N_{int} are in-plan intermediate purchases made by industrial firm k and non-industrial firm n, and F^Q_{it} is in-plan purchases made by final users. Final uses of the output include consumption, investment, net exports and net changes in inventory.

Turn next to the material balance in in-plan production. Here the no-diversion condition implies that in-plan resources must all be used in the production of in-plan output. The value of firm i's in-plan output in year t, Q_{it}, should therefore equal payments made to compensate for intermediate inputs, labor and capital used in in-plan production, plus any

[18]Equation (1) also implies no reverse diversion—buying goods from the market and reselling them in the plan. But this is almost guaranteed: since market prices are almost always higher than plan prices, there is little incentive for anyone to do reverse diversion.

indirect taxes and implicit taxes (or subsidies) that accrue to the government:

$$Q_{it} = \sum_j X_{jit} + V_{it}^Q, \tag{2}$$

where X_{jit} is firm i's in-plan purchase of firm j's output as an intermediate input, and V_{it}^Q is firm i's value-added from in-plan production that accrues to labor, capital, as well as the government in the form of indirect taxes and implicit taxes or subsidies.

But the material balance will not hold in the presence of official diversion. As corrupt officials divert goods from the plan to the market, they reduce the amount of in-plan goods available to meet either the distribution or the production requirements, for any given in-plan procurement. Official diversion therefore represents a "sink" in the plan (but a "source" in the market). As a result, the volume of official diversion can be estimated as the leakage in the plan.[19]

From (1), the leakage from in-plan distribution is simply $D_{it}^D = Q_{it} - \sum_k X_{ikt} - F_{it}^Q$. D_{it}^D measures the amount of in-plan output produced by firm i that is distributed outside of the plan. As in-plan output is diverted to outside-plan uses, firms producing in-plan output face a shortfall in the allocation of in-plan inputs. The resulting leakage in in-plan production is then $D_{it}^P = Q_{it} - \sum_j X_{jit} - V_{it}^Q$. D_{it}^P measures the amount of in-plan inputs diverted from firm i's in-plan production to other uses. Note that in general $D_{it}^D \neq D_{it}^P$, since they measure leakage in the plan along two different dimensions. They also include different types of leakage. D_{it}^D includes the diversion of in-plan goods destined for exports or rationed domestic consumption, while D_{it}^P includes the diversion of capital equipment and labor earmarked for in-plan production. However, the presence in the data of a statistically significant leakage measured by either D_{it}^D or D_{it}^P can be taken as evidence rejecting the null hypothesis that there is no diversion.

[19] Alternatively the volume of diversion can also be measured by analyzing resource flow in the market. Here official diversion is detected if the volume of market transactions exceeds the market supply from domestic producers and from imports. The plan-based and the market-based approaches are conceptually identical: they are the two sides of the same coin. But the market-based approach is more demanding on data. While in-plan procurement is levied on state-owned firms only, sources of market supply include non-state firms, for which there is no survey comparable in coverage to the survey of state owned firms that this paper uses. But for commodities produced primarily by state owned firms, such as steel, it is possible to estimate the amount of diversion using the market-based approach and aggregate data; see Li (2002b).

3.2 Data

This paper uses data from a survey of 769 Chinese industrial state-owned firms,[20] supplemented by the 1987 Chinese input-output table. Drawn from the State Statistical Bureau's national master sample of state-owned industrial firms, the survey sample consists of a diverse selection of firms, representing 36 (out of a total of 40) two-digit industrial sectors. While the sample contains disproportionately more large and medium sized firms, it appears quite representative of China's state-owned industrial sector along many dimensions. For example, the sample averages of output growth rate and labor productivity are nearly identical to the published national averages.

As shown in Table 1, the survey provides information on sample firms' participation in the dual-track system in the 1980's. Specifically, it provides data on each firm i's in-plan output value Q_{it} and in-plan purchases of intermediate inputs $\sum_j X_{jit}$ in year t, valued in plan prices. But it does not give a breakdown on the value-added from in-plan versus market production. Nor does it contain information on how each firm's in-plan output is distributed to in-plan intermediate and final uses. Fortunately, estimates of these unobserved variables can be constructed using the survey data supplemented by the 1987 Chinese input-output table.[21] The input-output data are combined with the survey data by matching the industrial sectors in the input-output table with the two-digit SIC codes used in the survey. In Table 2, I list the 22 industrial sectors in the input-output table, their matching SIC codes used in the survey, and the number of available observations for each of the industrial sectors in the survey sample. Below I use the available data to estimate the leakages in the plan.

3.3 Estimation of the leakage in in-plan production

Given the data on each firm's in-plan output (Q_{it}) and in-plan usage of intermediate input ($\sum_j X_{jit}$), the first step to estimating the leakage in a firm's in-plan production is to estimate its in-plan value-added. Using the survey data, I calculate the total value-added in firm i in year t, V_{it}, as the value of gross output minus the cost of intermediate inputs used in

[20] See Groves, Hong, McMillan and Naughton (1995) and Li (1997) for more information of the survey and the data.

[21] The 1987 input-output table is the first table for the Chinese economy constructed based on data collected from a carefully designed enterprise survey rather than relying on data collected for other purposes (Polenske, 1991).

that year. Under the presumption that the firm produces each unit of in-plan output in the same way as each unit of market output, the value-added or the contribution of primary factors embodied in each unit of output should be identical. An estimate of the in-plan value-added can thus be constructed as, $V_{it}^{Q} = V_{it}q_{it}$, where q_{it} is the ratio of in-plan output in real terms to total output in real terms.[22] In the first three columns in Panel A, Table 3, I list the sample averages of in-plan output ($Q_{.t}$), in-plan input ($X_{.t}$), and the estimated in-plan value-added ($V_{.t}^{Q}$). $V_{.t}^{Q}$ accounts for about one-third of the in-plan output.

The leakage in firm i's in-plan production in year t is then estimated as $D_{it}^{P} = Q_{it} - X_{it} - V_{it}^{Q}$. The sample average of the estimate in each year, which is simply the remainder after subtracting Columns 2 and 3 from Column 1, is reported in Column 4 in Panel A, Table 3. Since the estimate in each year is valued using that year's plan prices, it is not comparable over time due to inflation. To make comparison over time easier, I compute the size of diversion as a proportion of in-plan output, D_{it}^{P}/Q_{it}, and report its weighted average and the standard error of the average in Columns 5 and 6. The estimates show that a much higher proportion of in-plan output was diverted from in-plan production in the second half of the 1980's than in the first half. But before discussing the implications of the estimates, it seems prudent to first check the robustness of the estimates.

Conceptually, the estimates may be affected by sample selection biases. If value-added increases with firm size, the survey's over-sampling of large firms will lead to upward biases in the estimates of in-plan value-added and downward biases in the estimates of the leakage in in-plan production. To check the robustness of the estimates, I construct alternative estimates of the size of diversion using industry-level value-added data from the 1987 input-output table, which should not be affected by the possible sample selection biases.[23]

In the first column of Table 4, I list the primary input requirement coefficient, *i.e.*, the ratio of value-added to gross output, v_I, in each industry I from the 1987 input-output table. Using the ratios to approximate the primary input requirement coefficient for each sample firm i in industry I, the value-added attributable to in-plan production can thus be estimated as $V_{it,87}^{Q} = v_I Y_{it} q_{it}$, where Y_{it} is firm i's gross output. The sample averages of the alternative estimates of the in-plan value-added, the size of diversion, and the proportion

[22] Following Li (1997), real quantities are measured in constant 1989 market prices. Sample averages of q_{it} are reported in Column 3 in Table 1.

[23] However, using the input-output tables has a downside. Since the input-output table gives a static representation of the interdependence in the economy in 1987, using it to extrapolate value-added data for other years is likely to introduce biases as technology and institutions change over time.

of in-plan output diverted are reported in Panel B, Table 3.

Estimates of the in-plan value-added using the 1987 table (Column 1, Panel B) are very close to those estimated using the survey data (Column 3, Panel A), with the former only slightly higher between 1985 and 1989. As a result, the alternative estimates of the size of diversion (Column 2, Panel B) are statistically indistinguishable from those estimated using firm-level value-added data. This implies that the sample selection biases, if they exist, are likely negligible. This finding is consistent with the earlier observation that the survey sample is quite representative of China's state-owned industrial sector.

Inspection of the estimates in Table 3 may lead one to conclude that official diversion was not pervasive before 1985. But this interpretation is inconsistent with the anecdotal evidence presented in Section 2 and with Li's (2002a) statistical evidence of the effects of official diversion on resource allocation. A more plausible interpretation is that estimates of the size of diversion before 1985 are biased toward zero. The main reason, discussed in Section 2, is that official diversion before 1985 was carried out using implicit barter exchanges. Since corrupt officials reported these implicit corrupt exchanges as in-plan transactions, the survey data contain no information on the pre-1985 official diversion. As official diversion became monetized and marketized in 1985, it became statistically detectable. In 1985, the estimated size of diversion as a proportion of in-plan output rose to a statistically significant 12.46% (Panel A, Table 3). It continued to rise sharply to 37 percent by 1987 and retracted slightly to 30 percent by 1989. All the estimates from 1985 on are statistically significant. The null hypothesis of no diversion is strongly rejected by the data in the second half of the 1980's.

What explains the increase in the estimated size of diversion after 1985? Part of the answer may be that the downward biases fell gradually as the corrupt officials needed time to develop networks of briefcase companies. More important, however, the data may have captured the rapid increase in official diversion in the late 1980's. The monetization of diversion discussed earlier should have significantly reduced the transaction costs of diversion, thereby contributing to the increased pervasiveness of official diversion. In addition, the widening of the gap between market and plan prices reported in Table 1 should have given corrupt officials stronger incentives to divert in-plan goods in the late 1980's.[24]

[24]Regression analysis in Li (2002a) confirms a strong positive influence of the price gap on official diversion.

3.4 Estimation of the leakage in in-plan distribution

Since data on to whom and how much each firm's in-plan output is distributed are unavailable, it is not possible to estimate the leakage in the distribution of each firm's output. But it is possible to estimate an aggregate measure of official diversion in in-plan distribution. To see how, I write the leakage in the distribution of an average industrial firm's output as,

$$\frac{1}{N}\sum_{i=1}^{N} D_{it}^{D} = \frac{1}{N}\sum_{i=1}^{N} Q_{it} - \frac{1}{N}\sum_{i=1}^{N}\sum_{k} X_{ikt}^{I} - \frac{1}{N}\sum_{i=1}^{N}\sum_{n} X_{int}^{N} - \frac{1}{N}\sum_{i=1}^{N} F_{it}^{Q}, \tag{3}$$

where N is the total number of state-owned industrial firms. The leakage in the distribution of an average industrial firm's in-plan output is measured by the difference between the average firm's in-plan output and the sum of in-plan industrial and non-industrial intermediate uses and in-plan final uses of that output. If the survey sample is representative of the industrial SOEs in the economy, as the data appear to suggest, the first two terms on the right hand side of (3) can be estimated using the survey data. The first term, $\sum_i Q_{it}/N$ can be estimated by the sample average value of in-plan output. The second term, $\sum_i(\sum_k X_{ikt}^I)/N$ can be estimated by the sample average value of in-plan intermediate input. Estimates of the two terms are listed in the first two columns of Table 5. To estimate the last two terms on the right hand side of (3), I assume that the following in-plan distribution ratios were available: the proportions of each industrial sector I's in-plan output distributed to in-plan non-industrial intermediate uses (m_I) and to in-plan final uses (f_I). Using the industry distribution ratios as proxies to the distribution ratios of all firms in the same industry, I can estimate the last two terms in (3) as the sample averages of $m_I Q_{it}$ and $f_I Q_{it}$.

The assumed in-plan distribution ratios, however, are unobserved. To construct proxies for these ratios, I use the 1987 input-output table to compute two analogous ratios: the proportions of each industrial sector I's *total* output distributed for *all* non-industrial intermediate uses (m_I^*) and to all final uses (f_I^*). The resulting ratios are reported in Table 4. Using these ratios as proxies to the in-plan ratios, I construct estimates of the last two terms in (3) as sample averages of $m_I^* Q_{it}$ and $f_I^* Q_{it}$ and report the results in Table 5.

By definition, the assumed in-plan ratios and the estimated ones are not the same things. The in-plan ratios are *in-plan distributions* divided by *in-plan output*, while the estimated ones are *total (in-plan and market) distributions* divided by *total output*. In the presence of official diversion, the estimated ratios are in general larger than the in-

plan ratios. This is because official diversion by definition reduces in-plan distributions while increasing market distributions by the same amount for any given in-plan and market outputs. Official diversion therefore lowers the in-plan distribution ratios but not the total distribution ratios reported in Table 4. As a result, the total distribution ratios are biased estimates of the in-plan distribution ratios under the hypothesis of official diversion.

But under the null hypothesis of no diversion, the total distribution ratios would be good proxies of the in-plan ratios. Since in the absence of diversion, the plan and the market operate separately, any differences between the two ratios will simply reflect the differences in how the plan and the market allocate resources. If misallocation in the plan is arbitrary and tends to average out in aggregation, then one is unlikely to introduce systematic biases when using the total ratios to approximate the in-plan ratios. As a result, the in-plan distributions in the last two terms in (3) may be reasonably estimated using the total ratios under the null hypothesis of no official diversion.

Based on (3), I construct a test statistic of official diversion in in-plan distribution in each year by subtracting Columns 2–4 from Column 1 and report the results in Column 5. Dividing Column 5 by Column 1 gives the size of diversion as a proportion of in-plan output, which I report in Column 6. In Column 7, I give the standard error of the estimate of the proportion of output diverted. Under the null hypothesis of no diversion, the test statistic, which gives an unbiased estimate of the size of official diversion in the distribution, should be zero. This is contradicted by the estimates for years between 1986 and 1989, which are positive and are jointly and individually different from zero at the 5 percent level of statistical significance. In contrast, the estimates for 1980–85 are negative and statistically insignificant. The test statistics therefore reject the null hypothesis that official diversion did not exist in the late 1980's, although they fail to reject the null hypothesis for the first half of the 1980's. The estimates of official diversion in in-plan distribution are therefore qualitatively similar to the estimates of official diversion in in-plan production. The interpretation of the findings discussed in Section 3.3 is applicable here.

Compared with the estimates of diversion in in-plan production, the estimates reported in Table 5 are visibly smaller. This is expected. As discussed, the presence of official diversion causes upward biases in the estimates of the last two terms in (3), which in turn result in downward biases in the estimated size of diversion.

3.5 Proceeds from official diversion

The statistical analysis so far has documented sizeable diversion in the plan in the late 1980's. By buying the diverted goods at plan prices and reselling them at much higher market prices, corrupt officials captured substantial rents embodied in the plan. To estimate the proceeds from diversion, I revalue the diverted goods using average market prices, and then take the difference between market value and plan value of the diverted goods. In the first column of Table 6, I report the estimated proceeds from the diversion of in-plan production per sample firm. Since the in-kind official diversion before 1985 cannot be detected using the survey data, the table reports only the estimates for the years between 1985 and 1989.

Compared with an average high ranking official's annual salary of less than 10,000 yuan, the size of diversion proceeds, measured in millions of yuan per firm in the late 1980's, was astronomical. Indeed it is more appropriate to compare the estimated proceeds with the earnings of an average state-owned firm. Columns 2 and 3 show that the proceeds per firm were equal to over 40% of the value added and 65% of the profits of an average sample firm between 1987 and 1989. By multiplying the ratio of estimated proceeds to the value added by the share of industrial state-owned firms' contribution to GDP, I obtain back-of-the-envelope estimates of the size of the diversion proceeds relative to GDP. Reported in the last column, the estimates show that diversion proceeds amounted to nearly 10% of GDP between 1987 and 1989. In comparison, the consolidated government revenue between 1987 and 1989 averaged 16.6% of GDP.

4 Conclusion

This paper presents strong statistical evidence of the pervasiveness of official diversion under China's dual-track system. The underpricing of in-plan goods and the ensuing shortage on the plan track led to gains from trade between officials who controlled the allocation of in-plan goods and customers willing to pay more than the plan prices. By diverting goods from the plan and reselling them at higher market prices, official diversion creates a leakage in the plan. To estimate the scale of official diversion, this paper combines data from a survey of state-owned manufacturers with aggregate input-output data. My analysis of the data shows that the leakage in the plan became detectable after the introduction of the dual-track

system in January 1985. It also shows that the leakage increased sharply in the late 1980's. Between 1987 and 1989, approximately one-third of all in-plan output was diverted on average. Given the large price differential between market and plan prices shown in Table 1, the proceeds or rents from official diversion were staggering. Estimates of the proceeds per sample firm between 1987 and 1989 are equal to over 40% of the industrial value-added and 65% of the profits of an average sample firm. A back-of-the-envelop estimation shows that the rents from diversion in China's industrial planning bureaucracy amounted to about 10% of GDP between 1987 and 1989.

Since the government owned all in-plan goods and hence the implicit rents embodied in them, official diversion represented no trivial drain on the treasury (Gordon and Li, 1991). Between 1985 and 1989, as the proceeds from official diversion rose from 1.9% to 9.1% of GDP, the consolidated government revenue dropped from 22.4% to 15.8% of GDP, and continued to drop in the early 1990's. It started to rise from a low of 10.61% in 1995 after the government eliminated industrial planning. Official diversion of the kind documented in this paper disappeared as markets replaced industrial planning. But other types of corruption continued to proliferate.[25]

Corruption is much more than a redistribution of income from the government to corrupt officials. For one, the loss of government revenue may force the government to turn to more distortionary means of raising revenue. In the late 1980's, the Chinese government sharply increased the collection of seignorage income to more than 5% of GDP in order to monetize its deficit. One result of this policy was accelerating inflation in the late 1980's. Ironically, the inflation, which widened the gap between market and plan prices, helped make official diversion even more pervasive.

In addition, under China's dual-track system, corruption continued to exert an allocative role in the economy. The resulting allocation was distorted since corrupt officials would procure and divert more resources the larger the gaps between market and plan prices. Given the arbitrary under pricing of in-plan resources, some goods were over-procured and hence over-produced while others under-produced. But perhaps the most visible social cost of corruption may have come from public outrage against corruption and popular resistance to the reforms that were associated with corruption.

[25]For example, since the Chinese government continues to impose centralized control over the financial sector (Gordon and Li, forthcoming), corruption in the financial sector has been considered pervasive.

References

Ades, A. and Di Tella, R. (1999). Rents, competition and corruption, *American Economic Review* **89**: 982–94.

Alesina, A. and Weder, B. (1999). Do corrupt governments receive less foreign aid? NBER Working Paper 7108.

Chang, J. (1991). *Wild Swans: Three Daughters of China*, Simon & Schuster, New York.

Della Porta, D. and Rose-Ackerman, S. (2002). Corrupt exchanges: An introduction, *in* D. Della Porta and S. Rose-Ackerman (eds), *Corrupt Exchanges: Empirical Themes in the Politics and Political Economy of Corruption*, Baden-Baden: Nomos Verlagsgesellschaft, Germany, chapter 1, pp. 8–19. Interdisziplinäre Studien Zu Recht und Staat, 23.

Di Tella, R. and Schargrodsky, E. (2003). The role of wages and auditing during a crackdown on corruption in the city of Buenos Aires, *Journal of Law and Economics* .

Duggan, M. and Levitt, S. D. (2000). Winning isn't everything: Corruption in sumo wrestling. NBER Working Paper No. 7798.

Fisman, R. (2000). Estimating the value of political connections, *American Economic Review* . forthcoming.

Gong, T. (1994). *The Politics of Corruption in Contemporary China*, Praeger Publishers, Westport, Conn.

Gordon, R. H. and Li, W. (1991). Chinese enterprise behavior under the reforms, *American Economic Review Papers and Proceedings* **81**: 202–206.

Gordon, R. H. and Li, W. (forthcoming). Government as a discriminating monopolist in the financial market: The case of China, *Journal of Public Economics* .

Groves, T., Hong, Y., McMillan, J. and Naughton, B. (1995). China's evolving managerial labor market, *Journal of Political Economy* **103**: 873–892.

Hines Jr., J. R. (1995). Forbidden payments: Foreign bribery and american business after 1977. NBER Working Paper 5266.

Huang, W. (1996). *Zhongguo de Yingxing Jingji (The Hidden Economy in China)*, Commercial Publishing House, Beijing.

Huang, W. D. and Li, F. (1991). *Dangdai Zhongguo de Xiaofei Zhi Mi (Consumption Puzzles in Contemporary China)*, Commercial Publishing House, Beijing.

Kwong, J. (1997). *The Political Economy of Corruption in China*, M.E. Sharpe, New York.

La Porta, R., Lopez-de-Silanes, F., Shleifer, A. and Vishny, R. (1999). The quality of government, *Journal of Law, Economics and Organization* **15**: 222–79.

Lau, L., Qian, Y. and Roland, G. (2000). Reform without losers: An interpretation of China's dual-track approach to transition, *Journal of Political Economy* **108**: 120–43.

Li, W. (1997). The impact of economic reform on the performance of Chinese state enterprises, 1980–1989, *Journal of Political Economy* **105**(5): 1080–1106.

Li, W. (1999). A tale of two reforms, *Rand Journal of Economics* **30**: 120–136.

Li, W. (2002a). Corruption and resource allocation: Evidence from China. University of Virginia.

Li, W. (2002b). Corruption during the economic transition in China, *in* D. D. Porta and S. Rose-Ackerman (eds), *Corrupt Exchanges: Empirical Themes in the Politics and Political Economy of Corruption*, Baden-Baden: Nomos Verlagsgesellschaft, Germany, chapter 9, pp. 147–164. Interdisziplinäre Studien Zu Recht und Staat, 23.

Liu, B. (1979). *Ren Yao Zhijian* (between man and demon), *Renmin Wenxue (People's Literature)* pp. 83–102.

Mauro, P. (1995). Corruption and growth, *Quarterly Journal of Economics* **110**: 681–712.

Polenske, K. R. (1991). Chinese input-output research from a Western perspective, *in* K. R. Polenske and C. Xikang (eds), *Chinese Economic Planning and Input-Output Analysis*, Oxford University Press, Oxford, pp. 1–23.

Svensson, J. (2003). Who must pay bribes and how much? evidence from a cross section of firms, *Quarterly Journal of Economics* **118**.

Treisman, D. (2000). The causes of corruption: A cross-national study, *Journal of Public Economics* **76**: 399–457. UCLA manuscript.

Wei, S.-J. (2000). How taxing is corruption on international investors?, *Review of Economics and Statistics* **LXXXII**: 1–11.

Yang, S. and Li, J. (1993). *The Historical Role of the Dual-Track Pricing System (Jiage Shuangguizhi de Lishi Mingyun)*, Chinese Social Sciences Publishing House, Beijing.

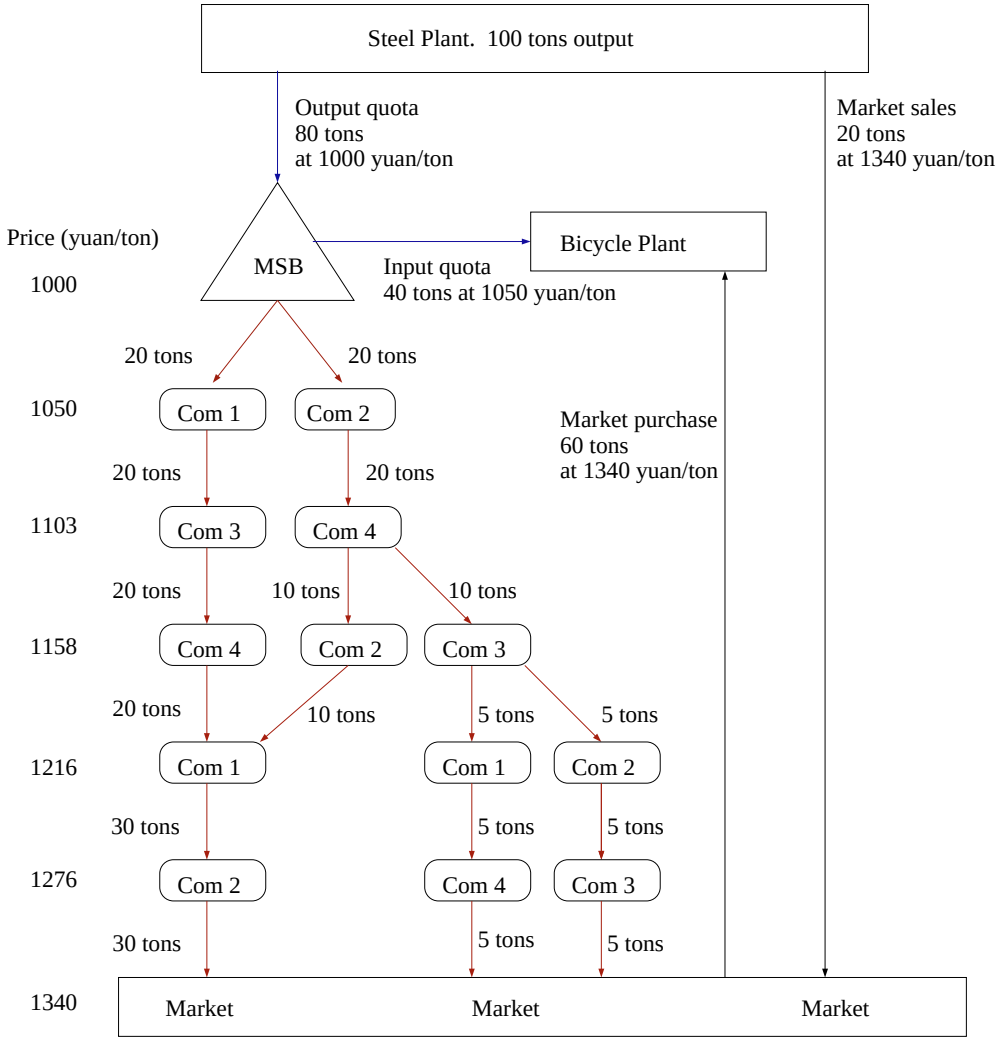

Figure 1: Briefcase companies and diversion. Here a hypothetical state-owned steel plant produced an output of 100 tons. It delivered 80 tons to the MSB at the plan price of 1000 yuan/ton and sold the remaining 20 tons in the market. The MSB resold at the plan price, plus a small markup (say 5%) approved by the government, 40 tons of in-plan steel to a state-owned bicycle factory, and 20 tons each to two authorized resellers (briefcase companies Com 1 and Com 2), which in turn resold the diverted steel for a small markup to two other resellers (Com 3 and Com 4). The four briefcase companies then resold the diverted steel among themselves and charged a small markup for each sale. In the end, the cumulated markups eventually brought the price to the market clearing level (1340 yuan/ton), and the diverted steel was sold on the market.

Table 1: The dual-track system as seen from a sample of state-owned enterprises. Prior to 1985, market prices were measured as "floating" prices, which remained under price control. By excluding possible in-kind payoffs and the costs of queuing, "floating" prices perhaps underestimated the implicit market-clearing prices.

	Output[a]			*Intermediate Inputs*[c]		
Year	$\frac{\text{market } P}{\text{plan } P}$	Market price inflation	In-plan procurement per firm[b]	$\frac{\text{market } P}{\text{plan } P}$	Market price inflation	In-plan delivery per firm[d]
1981	1.03	0.6%	32.2	1.22	1.3%	16.0
1982	1.05	2.4%	30.4	1.16	1.0%	16.8
1983	1.04	2.2%	32.0	1.16	2.0%	21.5
1984	1.06	3.2%	33.9	1.24	7.1%	20.4
1985	1.16	7.3%	36.2	1.30	5.2%	20.6
1986	1.26	9.3%	37.7	1.41	19.0%	17.4
1987	1.17	4.6%	45.6	1.60	11.9%	17.1
1988	1.16	22.0%	45.2	1.80	39.6%	14.1
1989	1.39	21.2%	44.2	1.65	18.7%	14.1

[a] The inflation rate of market output price, the ratio of market to plan prices, and the proportion of output sold to the plan are weighted by total product sales.

[b] Million yuan, measured in 1989 market prices.

[c] The inflation rate of market input price, the ratio of market to plan prices, and the proportion of input purchased from the plan are weighted by total input purchases.

[d] Million yuan, measured in 1989 market prices.

Table 2: Industrial sectors covered in the 1987 input-output table and the survey of industrial state owned enterprises

Industrial sectors in the input-output table	Matching 2-digit SIC codes covered in the survey	Available observations (1980-89)[1]
Coal mining	1	85
Crude petroleum and natural gas	2	0
Metal ore mining	3,4	24
Other mining	5,6,7,8,9	131
Electricity, steam and hot water	23	24
Food and beverage	10,11,12,13	245
Textiles	14	415
Wearing apparel	15,16	69
Sawmills and manufacture of furniture	17,18	g 35
Paper and educational articles	19,20,21,22	178
Petroleum refineries	24	30
Coking and coal processing	25	0
Chemical and pharmaceutical products	26,27,28,29,30	628
Building materials	31	307
Primary metal manufacturing	32,33	191
Metal products	34	57
Machinery	35	696
Transport equipment	36	107
Electric machinery	37	98
Electronic equipment	38	140
Instruments	39	66
Other industrial sector	40	0
Total		3526

[1] An observation for firm i in a particular year is available if the firm's output quota, input quota, and value-added for that year are not missing, and its output quota is non-zero.

Table 3: Estimation of the size of official diversion in in-plan production. Values of in-plan output and intermediate inputs, and the estimated size of diversion are all measured in current plan prices (10,000 yuan). In the last column, a single asterisk denotes 5% level of statistical significance and a double asterisk denotes 1% level of significance.

A. In-plan value-added estimated using firm-level data

Year	Value of in-plan output per firm $Q_{.t}$	Value of in-plan intermediate inputs per firm $X_{.t}$	Estimated in-plan value-added per firm $V^Q_{.t}$	Estimated size of diversion per firm $D^P_{.t}$	Percent of output quota diverted $D^P_{.t}/Q_{.t}$	Standard error
1980	1533	995	463	74	4.9%	7.9%
1981	1485	915	523	46	3.1%	5.8%
1982	1692	978	614	100	5.9%	4.8%
1983	2011	1238	734	38	1.9%	5.1%
1984	2239	1307	812	120	5.4%	7.5%
1985	2529	1372	842	315	12.5%	5.1%*
1986	2839	1263	964	612	21.6%	4.9%**
1987	4069	1415	1135	1520	37.4%	12.4%**
1988	4276	1424	1406	1446	33.8%	5.9%**
1989	4782	1824	1514	1444	30.2%	6.5%**

B. In-plan value-added estimated using the 1987 input-output table

Year	Value of in-plan output per firm $Q_{.t}$	Value of in-plan intermediate inputs per firm $X_{.t}$	Estimated in-plan value-added per firm $V^Q_{.t,87}$	Estimated size of diversion per firm $D^P_{.t,87}$	Percent of output quota diverted $D^P_{.t,87}/Q_{.t}$	Standard error
1980	1533	995	518	20	1.3%	7.3%
1981	1485	915	511	58	3.9%	4.9%
1982	1692	978	609	105	6.2%	4.2%
1983	2011	1238	729	44	2.2%	4.3%
1984	2239	1307	811	122	5.4%	6.1%
1985	2529	1372	857	300	11.9%	4.7%*
1986	2839	1263	995	582	20.5%	3.6%**
1987	4069	1415	1178	1476	36.3%	11.6%**
1988	4276	1424	1441	1411	33.0%	4.1%**
1989	4782	1824	1712	1247	26.1%	4.8%**

Table 4: Input-output coefficients based on the 1987 Chinese input-output table. The primary input requirement coefficient in industry i is the ratio of industry i's value-added divided by its gross output. The coefficient of non-industrial intermediate demand for industry i's output is the ratio of all intermediate uses by non-industrial sectors divided by industry i's gross output. The coefficient of final demand for industry i's output is the ratio of final uses of industry i's output divided by its gross output.

Industrial sector	Primary input requirement	Non-industrial intermediate demand	Final demand
Coal mining	0.60	0.20	0.21
Metal ore mining	0.52	0.00	-0.07
Other mining	0.63	0.63	0.00
Food and tobacco	0.26	0.16	0.64
Textiles	0.26	0.06	0.36
Wearing apparel	0.29	0.07	0.75
Sawmills and manufacture of furniture	0.32	0.46	0.20
Paper and educational articles	0.34	0.28	0.14
Eletricity, steam and hot water	0.58	0.22	0.09
Petroleum refineries	0.44	0.56	0.03
Chemical and pharmaceutical products	0.32	0.33	0.16
Building materials	0.41	0.78	0.01
Primary metal manufacturing	0.32	0.32	-0.12
Metal products	0.32	0.41	0.23
Machinery	0.35	0.16	0.44
Transport equipment	0.30	0.28	0.41
Electric machinery	0.30	0.19	0.41
Electronic equipment	0.28	0.07	0.48
Instruments	0.43	0.42	-0.06

Table 5: Estimation of the size of official diversion by the distribution approach using firm-level survey data and the 1987 input-output table. Values of in-plan output and intermediate inputs, and the estimated size of diversion are all measured in current plan prices (10,100 yuan). In the last column, a single asterisk denotes 5% level of statistical significance and a double asterisk denotes 1% level of significance.

Year	In-plan value of output quota per firm $Q_{.t}$	In-plan value of input quota per firm $X_{.t}$	Estimated intermediate in-plan use in service industries per firm $X_{.Nt}$	Estimated in-plan final use per firm $F^Q_{.t}$	Estimated size of diversion per firm $D_{.t}$	Percent of output quota diverted $D_{.t}/Q_{.t}$	Standard error[1]
1980	1501	918	360	352	-130	-8.7%	6.2%
1981	1490	861	357	365	-93	-6.2%	4.6%
1982	1672	914	409	388	-39	-2.4%	5.6%
1983	2007	1169	525	433	-120	-6.0%	6.7%
1984	2268	1253	589	498	-72	-3.2%	8.2%
1985	2534	1313	657	589	-25	-1.0%	6.0%
1986	2735	1198	712	628	196	7.2%	4.4%
1987	3872	1336	944	1018	573	14.8%	5.8%*
1988	4084	1361	1056	981	685	16.8%	4.3%**
1989	4545	1720	1165	1089	571	12.6%	5.0%*

Table 6: Proceeds from official diversion. Proceeds from diversion of in-plan production are the difference between the average market value (in millions of yuan) and plan value of the diverted goods per firm. Data on realized profits and value added are from the survey. To impute the proceeds as a proportion of GDP, I multiply the ratio of estimated proceeds to value added by the share of industrial state-owned firms' contribution to GDP.

	Proceeds from diversion	Proceeds as % of value added	Proceeds as % of profits	Proceeds as % of GDP
1985	0.72	7.3%	10.4%	1.9%
1986	2.05	18.4%	29.3%	4.7%
1987	5.85	43.6%	66.5%	10.6%
1988	6.94	41.6%	64.8%	9.7%
1989	7.51	40.0%	75.2%	9.1%