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FACTOR PRICE DISTORTIONS, RESOURCE ALLOCATION, AND GROWTH: A COMPUTABLE GENERAL EQUILIBRIUM ANALYSIS

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The present paper estimates the welfare cost of both labor and capital market distortions in South Korea using a computable general equilibrium model and expands on earlier studies by distinguishing autonomous differentials from *distortions in accounting for differences in sectoral wages and returns to capital. Our results show that removing labor market distortions would increase output by less than 1% of the base year GDP. Even when capital market distortions are also removed, the GDP increases only by 3.2%. The study also examines a dynamic consequence of capital market distortions which suggests that distortions may lead to more rapid capital formation and higher concentration of capital stock. Given the industrial policy configuration in Korea, we find that financial incentives had more distorting effects than fiscal incentives.*

I. INTRODUCTION

One of more nagging puzzlements in economics is that whereas allocative effciency has occupied a lofty position in theory, empirical evidence as well as theoretical results have, more often than not, failed to support the theory.[1]

Most of the studies dealing with the cost of distortion have focused either on the theoretical aspects of distortions, or on the casual observation of actual data; only a few systematic empirical studies are now available. Recent advances in the

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[1]For example, Fishlow and David (1961) and Johnson (1966), among others, used an abstract two commodity, two factor model and reached the conclusion that even severe distortions have a negligible effect on economic efficiency or welfare. Although Harberger's study on Chile (1959) had yielded a welfare loss of 9-15%, it was intended by the author as an extreme case. Also see Leibenstein (1966) and Dougherty and Selowsky (1973) for their summary of earlier empirical reselts, and Magee (1971) for a review of the literature.

empirical analyses of distortions consist of studies by Dougherty and Selowsky(1973) on Colombia, and by Fløystad(1975) on Norway which estimate static welfare cost of factor distortions based on the partial equilibrium framework. De Melo(1977) went one step further by presenting a computable Walrasian general equilibrium(CGE) model. De Melo's study is noteworthy for two reasons: first, for its methodological innovation, and second, for the distinctive magnitude of the measured welfare cost. Unlike all previous results, his results show a 13.3% increase in GDP resulting from the removal of distortions. As such, de Melo's study generates a renewed interest in the subject matter. Given de Melo's new figure, if we were to draw any general conclusion on the effect of distortions, we need to collect additional sample points based on a similar model.

The objectives of this study are; (1) to estimate the welfare cost of factor market distortions in South Korea; and (2) to investigate a dynamic consequence of capital market distortions by examining their impacts on the sectoral distribution of capital stocks, and on the economy's total capital formation. Although this study utilizes a CGE model which is basically the same as de Melo's, its implementation of the model differs from de Melo's in several important respects. First, it examines distortions in both capital and labor markets whereas de Melo has dealt with the labor market distortions only. Second, unlike in de Melo's study, a distinction is made here between *autonomous differentials* and *distortions* in accounting for differences in wages and returns to capital.[2] Third, this study is more comprehensive than de Melo's in that in incorporates a greater number of factors of production (5 type of labor vs. 2 types) and a greater number of sectors(27 sectors vs. 15 sectors); a greater degree of disaggregation makes for a more accurate (if sectors vs. 15 sectors); a greater degree of disaggregation makes for a more accurate (if not total) distinction between autonomous differentials and distortions. Fourth, unlike de Melo's, our study is based on the fixed exchange rate regime rather than the flexible exchange rate regime; the welfare index is more sensitive to the alternative exchange rate regime than the output index. Last but not least, this study is an extension of de Melo's in that it investigates a dynamic consequence of capital market distortions.

In spite of its rapid economic growth, the South Korean economy has been notorious for factor market distortions arising from governmental policy intervention. According to Hong's (1990) account the annual provision of interest subsidies expanded from 3 percent of the GNP in 1962-71, to 10 percent of the GNP in 1972-79. In addition, the government-directed interest subsidies on foreign loans to private businesses averaged 6 percent of the GNP each year in the 1970s. During the 1971-81 period, the ratio of the average bank-loan to value-added for the

[2]Differentials which are autonomous (e.g., differences in technical characteristics, risk, and adjustment costs for capital equipment; and education, skill, age, and experience among workers) are not a source of welfare distortion. See Magee (1973) and Harcourt (1969).

capital-intensive group of manufacturing sectors exceeded that for the labor intensive group by 20 to 32 percent. If foreign borrowings are included, the ratio would be 120-170 percent larger than that for the labor-intensive group. Given the uniqueness of its capital market environment, Korea presents itself as an interesting case study of allocative inefficiency.

Section II below describes the theoretical framework. Section III reports the results of static simulations and Section IV discusses a dynamic consequence of capital market distortions. Summary and conclusions follow.

II. THEORETICAL FRAMEWORK

The multisector CGE model used in the present study is especially suited for the treatment of market distortion in that, within the system, prices and quantities in all markets are determined simultaneously through interactions with one another. Several key characteristics of the model are provided in the appendix, and the reader is also referred to Paik(1991) for further details.[3] The core model consists of a simultaneous equation system which describes output supply, input demand, final demand, international sector, and price normalization. On the supply side, Cobb-Douglas production functions are specified for six primary factors; capital and five type of labor. Following Johansen(1960), labor and capital are assumed to be substitutable factors of production, while production coefficients for intermediate inputs, including non-competitive imports, are fixed. Profit maximization by firms determines demand for primary factor inputs and factor returns are endogenously determined from the factor demand equations. On the demand side, consumers face the Stone-Geary utility function which leads to consumer demands that are linear in prices and expenditures. In conformity with the small country assumption, prices of traded goods are presumed to be determined by world prices. Since South Korea was under the fixed exchange rate system in the year under investigation, a fixed exchange rate system is modeled by allowing the balance of payments to vary freely while keeping the exchange rate fixed. Also to reflect the dualistic nature of the economy, a dual wage structure between rual and urban areas is assumed.

In recent studies of distortions, we find that sectoral differences in labor's marginal product are treated as distortionary; yet the differences in returns on capital are either untreated because of the unreliability of capital stock data(de Melo, 1977), or treated as distortionary in their entirety(Fløystad, 1975). In this study, however, to ensure a more accurate distinction between autonomous differentials and distortions, a detailed breakdown of labor is attempted. More importantly, an attempt is made to distinguish distortions from autonomous differentials in the returns

[3]Other results are available upon request.

[**Table 1**] Factor Scale Parameters for Capital(1978)

Sector	Capital to Value-added Ratio	Distortion Parameter (d_i)	Factor Scale Parameter (with both distortions & differentials) (ε_i)	Distortion-free Factor Scale Parameter (with autonomous differentials only) (ε_i^*)
Mining	1.144	0.853	0.858	1.005
Food	2.007	1.125	1.604	1.425
Beverage	1.496	1.313	3.522	2.681
Tobacco	1.794	1.125	3.045	2.707
Textiles	2.489	1.125	1.219	1.083
Leather	0.788	1.165	3.877	3.326
Wood & Furniture	2.011	0.893	1.402	1.569
Paper Product	2.189	1.178	1.427	1.211
Printing	4.091	1.462	0.464	0.317
Chemicals	1.719	0.927	2.186	2.358
Petroleum Refineries & Petroleum Products	1.904	1.183	2.692	2.274
Rubber Products	2.261	0.870	1.082	1.242
Nonmetal	3.030	0.733	1.128	1.537
Primary Metal	4.126	0.585	1.036	1.769
Fabricated Metal	2.636	1.176	1.042	0.886
Machinery	3.312	0.734	1.019	1.387
Appliances	1.574	0.965	2.546	2.636
Transport Equipment	2.666	0.726	1.135	1.563
Measuring, & Optical Equipment	1.188	1.075	2.072	1.926
Other Manufacturing	2.067	0.996	1.533	1.539
Electricity, & Gas	8.826	0.638	0.506	0.792
Construction	0.913	1.163	2.614	2.246
Wholesales, & Retail Trade	0.886	1.299	3.130	2.409
Transportation, & Communication	4.654	1.019	0.763	0.749
Financing, & Business Services	14.377	0.602	0.297	0.493
Community, & Social Services	1.731	1.057	0.385	0.364

Note: The average return on capital(15% in the base year) can be multiplied by factor scale parameters for capital(ε_i's) to yield sectoral returns on capital.

on capital. Technically, this is achievable by computing distortion-free scale parameters from the factor scale parameters ($\varepsilon_i^*$and ε_i in equations 2 in appendix A). The factor scale parameters relate the sectoral rate of return to the economy wide average rate of return, and can be computed from factor demand equations (equation 2 in appendix A) using the base year data, reflecting differences in the marginal product of factors across different sectors.

The experiments are based on Korean data for 1978, because it happens to be the only year in the peak period (1976-79) of the government's so-called heavy/chemical industrial(HCI) drive for which the I/O table is available.

Table 1 presents distortion parameters, the factor scale parameters, and the distortion-free factor scale parameters for capital stock along with the value-added to capital ratios for the base year. Distortion parameters (d^i in equations 2 in appendix A) represent ratios of sectoral rental prices incorporate both financial and fiscal distortionary measures.[4] A distortion parameter lower(or higher) than one reflects a higher(or lower) degree of investment incentives provided by the government. Dividing the factor scale parameters ε_i by the distortion parameters d_i yields factors scale parameters representing autonomous differentials. The factor scale paramter (ε_i) less than one(or greater than one) implies that the sector's return is less (or greater) than the economy wide average, and does not distinguish distortions from differentials. In contrast, distortion-free factor scale parameters capture the autonomous differentials only.

In Table 1, it shown that the rate of return on capital widely varies across sectors. The returns on capital range from 4.5% for business services to 58.2% for leather. It also suggests that the government's incentive policies under its HCI plan caused several key heavy manufacturing industries, *i.e.*, primary metal, machinery, and transport equipment, to adopt, in rapid progression, a relatively more capital-intensive production technology. Had distortions been removed from these sectors, their scale parameters for capital would have increased (e.g., from 1.036 to 1.769 for primary metal), implying that without distortions marginal products of capital in HCI might have been higher. In contrast, light industries, *i.e.*, food, beverages, tobacco, textiles, and leather, with higher scale parameters with distortions maintained, experience decreasing factor scale parameters as distortions are removed(e.g., from 3.522 to 2.681 for beverage).[5]

Table 2 summarizes the base year economy, disaggregated into twenty seven sectors including five non-traded sectors. The signs in the parentheses for traded sectors show if the sector is a net exporter(+) or a net importer(-). Goods that are imported but not produced domestically are lumped into a non-competitive import sector. Multiplying column (1) by column (2) yields sectoral value-added. The returns to labor are provided along with the number of worker, and sectoral capital stock. From wage data in columns (3) to (7) we observe that community and social services have higher wage rates because they include high-paying activities such

[4]See section IVfor a further discussion of the computation of sectoral rental prices.

[5]Factor scale parameters, with autonomous differentials only, decrease for light munufacturing sectors, since increases in capital stock reduces marginal product of capital in these sectors.

[**Table 2**] Actual Wages and Employment of Capital and Labor By Sector, 1978

Sector	Gross Output Millions of Won	Value added (%)	Wages(Value of Marginal Product of Labor) Type I: Thousands of Won	Type II: Thousands of Won	Type III: Thousands of Won	Type IV: Thousands of Won	Type V: Thousands of Won	Capital Stocks Millions of Won	Quantity of Labor Type I	Type II	Type III	Type IV	Type V
Agriculture(-)	6642193	73.2	1,239	2,924	1,113	548	567	3720370	418735	226176	1290632	987151	1393260
Mining(-)	503160	68.7	1,398	2,573	1,043	597	833	395029	1933	1558	9247	2596	119002
Food(-)	2307225	21.7	1,257	2,729	1,081	795	573	1006825	5706	8085	50179	14789	199957
Beverage(+)	866141	19.7	514	935	465	433	301	255467	398	2005	12833	5241	28336
Tobacco(+)	593837	18.3	434	784	387	362	250	195733	226	1142	7296	2984	16111
Textiles(+)	4318259	24.1	1,275	2,115	930	98	440	2594652	5655	12995	68142	18182	829453
Leather(+)	518475	25.8	1,932	4,109	1,345	931	724	105618	506	12995	68142	18182	829453
Wood & Furniture(+)	668040	22.7	1,133	2,608	1,089	662	672	305176	401	1421	8973	1746	85481
Paper Product(-)	466937	27.0	1,630	3,131	1,264	907	805	275692	958	2256	9538	1863	39860
Printing(-)	227850	35.5	1,583	2,558	1,217	641	777	331448	5614	2147	9355	1186	29930
Chemicals(-)	2608051	23.9	2,988	3,836	1,692	1,096	960	1071266	7277	7224	39321	12478	90686
Petroleum Refineries & Petroleum Products(-)	1889837	13.9	2,261	3,727	1,651	908	1,187	501948	1061	1M47	6562	1218	14057
Rubber Products(+)	548519	22.0	1,990	4,015	1,825	972	787	273278	225	639	3788	385	68944
Nonmetal(+)	789686	36.6	2,186	3,612	1,652	1,091	908	876554	1996	2370	15047	2411	79052
Primary Metal(-)	2138762	16.4	1,735	3,639	1,491	979	1,045	1448872	3016	2097	10831	1836	57929
Fabricated Metal(+)	636177	24.0	2,076	3,643	1,544	995	926	402610	1228	1558	733M	1614	57787
Machinery(-)	649986	31.4	1,876	2,687	1,152	693	862	675506	3837	2605	10150	1444	62111
Appliances(-)	1972447	22.5	1,252	2,381	975	649	448	700703	3981	3574	27477	3836	202712
Transport Equipment(-)	1352154	25.8	1,886	3,507	1,560	1,136	1,081	931319	8122	4732	14609	3887	89956
Measuring, & Optical Equipment(-)	222490	24.4	2,266	4,268	1,602	932	764	64527	342	596	3051	728	26150
Other Manufacturing(+)	563279	30.4	1,450	2,348	950	493	426	354582	354	2485	14120	3161	121053
Electricity, & Gas	749735	42.3	2,776	4,831	2,815	1,615	2,477	2815324	7378	886	8804	176	9464
Construction(+)	4006424	36.9	1,554	2,577	1,125	494	785	1350363	205888	50700	174341	14634	188593

[**Table 2**] Actual Wages and Employment of Capital and Labor By Sector, 1978

Sector	Gross Output Millions of Won	Value added (%)	Wages(Value of Marginal Product of Labor) Type I: Thousands of Won	Type II: Thousands of Won	Type III: Thousands of Won	Type IV: Thousands of Won	Type V: Thousands of Won	Capital Stocks Millions of Won	Quantity of Labor Type I	Type II	Type III	Type IV	Type V
Wholesales, & Retail Trade	4888368	78.9	1,128	2,842	1,046	551	942	3438829	32130	105638	777946	922313	221232
Transportation, & Communication	2760439	55.0	2,892	3,288	1,056	984	1,129	7023626	11141	13565	141259	9113	287784
Financing, & Business Services	2028906	72.2	1,440	2,444	1,132	553	900	21059275	1223	30139	239563	34003	16762
Community, & Social Services	4961217	59.3	4,338	4,037	1,746	817	1,375	5061229	390306	32617	239371	194007	185416
Column	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)

Note: Type I worker = Professional & technical; Type II = Administrative & managerial; Type III = Clerical; Type IV = Sales & services; Type V = Production line.

as private and public medical services and education.[6] Columns (9) to (13) indicate that proportions of different types of labor vary widely across sectors (e.g., 88% for production line workers (Type V) in textiles as compared to 17.8% in community and social services). From the table we also find some correlation between capital stock and the marginal product of labor. For instance, the marginal product of labor in sectors with a higher capital to value-added ratio, *i.e.,* primary metal, machinery, and transport equipment, tends to be higher than those of sectors whose capital to value-added ratios for primary metal and beverages are 4.126 and 1,496, respectively, while annual wage rates for Type V workers in the same sectors are 1,045 and 301 thousands won, respectively.[7] The implication here is that capital market distortion can cause sectoral differences not only in returns on capital, but also in the marginal product of labor, and, possibly, wages.

III. EMPIRICAL RESULTS

Static simulations were conducted for three different assumptions regarding factor mobility and/or the removal of distortions. However, in all cases the removal of distortions in the labor market is assumed. Differentiation of three experiments are summarized in Table 3. In the first experiment, capital stock is fixed. In the second, capital stock is mobile, but distortions are still maintained, albeit differently in their patterns.[8] Capital migrates only when sectoral returns to capital are affected by changes in the quantity of labor. In case three, distortions are removed in the capital market; capital migrates across sectors untill differences in the marginal procuct of capital reflect only autonomous differentials. The fixity of capital implies short-run adjustment in which case returns to capital is determined residually from the demand equations for factor input(see equation 2 in appendix A), whereas capital mobility implies longer term adjustment. To the extent that adjustment costs not considered, the reported estimates can overestimate the welfare cost(or gain).

Following de Melo's dual-wage structure assumption, removal of distortions in the labor market in the urban sector is achieved by setting all the differentials for labor equal to one ($\varnothing_{si}$ i = 2....27 in equations 2 in appendix A), recalculating the differential for the rural sector such that constant rural-urban wage ratios (RU_s in equations 4 in appendix A) are maintained for all types of labor. Given the dualistic nature of Korea's economy, at least during the period under investiga-

[6]Sectoral wage rates are obtained by multiplying the average economy wide wage rates by the corresponding scale parameters (ϕ_{si} in equation (2)in appendix A)for five types of labor.

[7]See Table 1 for capital to value-added ratios; for wage rates, see col. (3)-(7) in Table 2.

[8]The magnitude and distribution of distortions across the sectors may be different from that of case one.

[**Table 3.**] Type of Static Experiments

	Factor Mobility		Distortions		Remarks
	Labor	Capital	Labor Market	Capital Market	
Experiment I	Mobile	Fixed	Removed	Maintained	
Experiment II	Mobile	Mobile	Removed	Maintained	Capital migrates to the extent that marginal product of capital is afiected by labor migration.
Experiment III	Mobile	Mobile	Removed	Removed	Capital and labor migrate freely so as to remove distortions, but not autonomous differentials.

tion, a dual-wage structure is assumed to have persisted even after a removal of distortions in the urban sector. When capital market distortions are removed, factor scale parameters for capital (ε_i for $i = 2...27$ in equation 2 in appendix A) are set equal to the values of distortion-free factor scale parameters (ε_i^*) in Table 1 so that differences in sectoral returns to capital obtained in the solution process reflect autonomous differentials only.

A. Welfare Effects

Given the complexity of the *tâtonnement* process occuring in the model, it is worth repeating here a brief description of how it works. First, sectoral outputs are determined from the reallocation of factor inputs. Intermediate demand for sectoral outputs is determined by fixed input-output coefficients. With remaining final demands being exogenous, consumption for non-traded goods is residually determined. Prices for non-traded goods then adjust to equate demand and supply for the non-traded goods satisfying the price normalization rule subject to the fixed-exchange rate assumption. Prices of traded goods are determined by the world prices via the constant exchange rate. Households decide how much traded goods to consume based on the relative prices between non-traded goods and traded goods subject to households' budget constraints. Consumption of traded goods in excess(short) of domestic production must be imported(exported).

The estimates of the welfare effects that from removing distortions are presented in Table 4. Let us begin by pointing out the relative sensitivity of welfare indices over GDP indices in terms of types of exchange rate systems. Under a flexible exchange rate system, prices of traded goods tend to be more flexible than they are under the fixed exchange rate regime as the exchange rate adjusts to correct domestic imbalances in production and consumption. Under the fixed exchange rate regime, however, prices of traded goods are fixed unless world prices change. Therefore, consumption of traded goods has to change to a greater extent when

[**Table 4.**] Effects of Removing Factor Market Distortions
(all figures represent % changes)

	Welfare	GDP[a]	Type I Wage	Type II Wage	Type III Wage	Type IV Wage	Type V Wage	Rate of Returns to Capital
Experiment I	2.39	0.42	-0.34	4.32	4.7	9.5	-0.35	5.2
Experiment II	5.70	0.58	-8.5	-1.1	-0.7	4.1	-8.7	12.4
Experiment III	5.55	3.17	-3.7	-3.6	-0.9	-1.6	-4.7	1.36

[a]GDP valued at base year prices.

prices of non-traded goods are altered. Accordingly, changes in welfare indices(which is sensitive to consumption) can be larger under the fixed exchange rate regime. Table 4 shows a 2.4% increase in the welfare index when capital is fixed, a 5.7% increase when capital is mobile, and a 5.6% increase when capital market distortions are removed. Welfare may increase because imports of traded goods increase due to the reallocation of resources, thus increasing tariff revenue. As tariff revenue is increased, disposable income for households increases because of the decrease in taxes on factor income necessary to offset the increase in tariff receipts(de Melo, 1977). As a result, consumption increases, hence an increase in welfare, Also, the increase in welfare is larger when capital is mobile, or when distortions are removed in the capital market, because production and consumption of non-traded goods increases more rapidly in these two cases. Non-traded sectors have larger marginal expenditure shares in the Stone-Geary utility index, thus increasing welfare.

Having observed numerous results of the welfare cost of distortions published over the last three decades, we find it is especially noteworthy that changes in GDP are less than 1% not only when capital is fixed but also when it is mobile. Small output gain under the mobile capital case is possible, because as factors of production are reallocated, an increase in output in one sector can be offset by a decrease in output of another sector(s). GDP increases only by 3.2% when distortions are removed in the capital market. The small increase in output arises from the fact that the removal of subsidies from a sector (especially in heavy manufacturing sectors) increases production costs, thus reducing the sector's output and exports while simultaneously increasing imports. Perhaps, more to the point, the removal of capital market distortions leads to the migration of capital from highly capital intensive sectors to less intensive sectors; it may lead to an increase in the marginal product of capital in general and some increase in output. This is, however, likely to be followed by a concurrent migration of labor in the same direction as the capital. This occurs because the reduction in capital stock will lower the marginal product of labor in the same sector, thus causing labor to migrate out of the sector. As workers migrate to a new sector, they become less productive than they were in the highly capital-intensive sector, thus leading to a decrease in output. As a result, the output effects of factor movements across sectors will offset each other, leading to a small net gain in output(Hayashibara and Jones, 1989).

Turning to labor markets, Table 4 shows that although the average rate of returns on capital increases(5.2%, 12.4%, and 1.4%, respectively) in all cases, average wage rates may not, suggesting that the GDP increase is not substantial. In experiment II(mobile capital) average wage rates decline(note an 8.5% reduction for type I and 8.7% reduction for type V) as wage rates in heavy manufacturing and services decrease due to increases in labor in these sectors. In experiment III when distortions are removed in the capital market, they decline also(a 3.7% reduction for type I and 4.7% reduction for type V) because the migration of capital out of heavy manufacturing sectors reduces the marginal product of labor in these sectors, leading to a substantial decline in wages. At the same time, the maintenance of a constant rural-urban wage ratio for production line workers warrants an increase in the number of rural workers and a lowering of rural wage rates. This may occur because the decrease in the wage rate for the heavy manufacturing sector is relatively larger than that of the rural wage rate. Likewise, with falling wage rates, wage-rental cost ratios for the heavy manufacturing sectors decline also. And in some areas, *i.e.*, primary metal and machinery, labor decreases in spite of lower wage-rental price ratios (see Table 5(to be presented later), col. (18), *i.e.*, 19.1% reduction for primary metal and 15.4% reduction for machinery), thus implying that capital and labor are not perfect substitutes in Korean manufacturing.[9]

B. Structural Effects

Table 5 shows the new allocation of factors in each experiment, along with corresponding changes in value-added are larger for non-traded sectors, whose output prices are determined endogenously, and remain relatively small for traded sectors reflecting the fixed exchange rate regime. Changes in value-added may also reflect changes in input prices. For instance, a decrease in the price of inputs(*i.e.*,wages) decreases the value-added as in the case of community and social services, a sector whose wages are above the average(see Col.(1)in Table 5 and also Table 2).[10]

When capital is fixed, labors migrate into heavy manufacturing and services

[9]Though not reported in this study, another experiment, conducted with removal of both autonomous differentials and distortions (which is tantamount to treating both as distortions) in the capital market for manufacturing sectors only, yielded a GDP gain of 7.4%, However, in the same experiment with autonomous differentials retained, the GDP gain turns out to be 2.9%, which is virtually the same as the 3.2% from the experiment *III* in Table 4.

[10]The value-added is computed by subtracting intermediate input costs and indirect business taxes from the output price, thus showing factor payments for the primary inputs.

[**Table 5**] Equilibrium Net Prices, Employment And Output
(all figures are percentages of initial values)

	Value-added			Type I Labor			Type II labor			Type III Labor		
Capital	Fixed	Mobile	Distortion-Free	Fixed	Mobile	Distortion-Free	Fixed	Mobile	Distortion-Free	Fixed	Mobile	Distortion-Free
Agriculture	99.8	99.8	99.8	130.2	116.2	115.1	107.5	101.9	94.4	107.3	97.1	92.3
Mining	100.5	99.8	98.5	50.5	51.5	44.8	87.8	92.0	85.1	87.4	91.8	83.0
Food	99.3	98.4	99.6	39.5	32.7	41.6	79.5	67.8	92.4	77.4	66.2	88.2
Beverage	100.4	100.4	101.5	19.1	14.0	26.9	30.8	23.7	49.4	36.7	28.6	58.4
Tabacco	100.4	99.9	100.5	17.0	12.2	18.3	26.8	20.3	32.4	31.6	24.3	37.8
Textiles	98.9	98.4	98.2	35.2	25.7	31.9	54.7	40.9	54.1	58.7	44.1	57.0
Leather	97.9	98.1	99.5	63.5	60.8	77.7	128.1	125.6	172.6	103.7	101.5	136.4
Wood & Furniture	97.8	97.8	98.4	36.3	31.3	31.5	76.6	68.7	72.8	78.4	70.6	73.0
Paper Product	99.6	98.3	97.4	56.0	52.9	64.6	101.9	98.6	129.2	101.0	98.0	125.4
Printing	102.0	101.2	101.4	51.1	47.5	61.6	78.6	74.7	104.0	91.0	87.1	118.4
Chemicals	100.4	99.1	99.5	76.4	79.2	78.2	133.7	141.3	149.3	144.3	153.1	158.4
Petroleum Refineries & Petroleum Products	100.6	99.8	99.0	78.7	75.0	111.8	124.8	120.7	194.4	135.3	131.4	206.6
Rubber Products	98.3	97.7	98.1	68.6	69.2	63.6	131.8	136.0	133.4	146.4	151.8	145.3
Nonmetal	100.9	99.0	97.9	79.9	82.2	60.8	127.0	132.7	105.0	142.0	149.1	115.0
Primary Metal	100.6	98.3	97.0	62.7	60.2	35.1	124.6	122.5	74.8	125.3	123.5	73.7
Fabricated Metal	99.8	98.5	98.1	77.0	82.4	95.5	129.6	141.2	176.3	134.7	147.2	179.4
Machinery	99.1	98.8	97.8	63.2	59.9	46.5	87.1	83.9	69.4	91.4	88.4	71.4
Appliances	99.4	99.1	100.2	38.4	29.5	33.6	68.0	53.8	65.0	68.3	54.2	64.0
Transport Equipment	99.0	98.7	99.5	70.7	78.2	60.2	125.6	141.8	116.6	136.7	155.0	124.3
Measuring, & Optical Equipment	99.5	99.2	99.0	78.9	81.9	87.3	142.4	150.6	172.4	131.5	139.2	155.6
Other Manufacturing	97.7	97.8	97.2	39.6	29.4	33.0	60.6	45.8	54.7	60.2	45.7	53.3
Electricity, & Gas	62.5	92.1	119.3	62.6	94.6	113.6	104.2	161.0	208.4	147.2	230.0	290.5
Construction	99.7	99.3	100.5	44.1	36.2	44.7	69.2	58.0	76.8	73.8	62.2	80.4
Wholesales, & Retail Trade	113.1	114.1	94.6	45.3	46.4	40.4	105.7	112.6	103.6	95.8	102.1	91.9
Transportation, & Communication	89.8	100.1	95.0	89.5	110.1	102.5	99.3	123.2	123.8	79.2	97.7	96.2
Financing, & Business Services	122.8	116.8	153.9	60.4	68.2	79.4	97.9	113.0	141.4	110.7	128.5	157.9
Community, & Social Services	73.3	72.3	73.6	108.4	126.5	123.7	99.9	116.3	123.0	105.8	123.6	127.6
Column	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)

Note: Type I worker = Professional & technical; Type II = Administrative & managerial; Type III = Clerical, Type IV = Seles & services; Type V = Production Line.

[**Table 5.**] Continued

	Type IV Labor			Type V Labor			Capital Stock		Physical Output			Rate of Return On Capital		
Capital	Fixed	Mobile	Distortion-Free	Fixed	Mobile	Distortion-Free	Mobile	Distortion-Free	Fixed	Mobile	Distortion-Free	Fixed	Mobile	Distortion-Free
Agriculture	102.9	93.1	93.2	115.6	114.8	114.7	91.0	99.7	108.3	101.5	99.7	108.1	111.2	99.6
Mining	96.2	101.3	96.3	116.2	121.9	104.9	95.0	81.2	105.9	107.6	94.7	106.4	113.1	114.4
Food	108.3	93.5	130.8	69.5	58.8	75.0	66.4	109.1	88.1	67.8	95.7	87.5	99.4	87.0
Beverage	62.7	50.1	108.0	39.7	30.8	60.3	64.2	189.5	90.4	62.7	155.8	90.8	96.5	84.2
Tobacco	53.8	42.5	69.5	34.1	26.1	39.0	64.7	123.8	91.8	63.6	110.6	92.1	96.7	89.7
Textiles	15.3	10.4	14.7	47.6	35.2	43.7	51.2	81.2	73.9	47.8	65.0	73.1	90.1	77.4
Leather	137.4	135.3	191.4	94.5	91.5	117.7	82.0	141.2	99.7	90.2	129.2	97.7	107.3	91.6
Wood & Furniture	91.4	82.6	89.3	81.3	72.6	71.9	70.2	71.9	90.5	74.1	74.9	88.5	102.3	101.6
Paper Product	138.3	135.2	182.0	108.0	104.1	127.5	84.1	139.5	101.8	92.8	128.6	101.4	108.0	90.2
Printing	92.5	88.7	126.9	97.6	92.7	120.6	77.4	168.4	90.0	80.8	118.8	91.9	104.9	71.9
Chemicals	179.6	191.3	208.3	138.2	145.3	143.8	98.6	104.9	110.6	111.9	116.5	111.0	1124	110.7
Petroleum Refineries & Petroleum Products	143.6	139.6	231.4	162.9	157.4	236.8	86.6	177.2	104.6	93.7	169.4	105.3	107.5	95.7
Rubber Products	150.6	156.3	157.6	107.6	109.9	101.0	90.8	84.4	105.9	103.8	97.1	104.2	111.5	112.6
Nonmetal	180.2	190.0	154.0	131.9	137.2	101.2	98.2	62.5	110.9	111.9	80.2	111.9	112.9	124.3
Primary Metal	157.8	156.3	97.7	147.2	144.3	81.9	90.2	36.3	107.8	100.8	49.8	108.5	109.6	129.6
Fabricated Metal	166.7	182.9	234.8	136.0	147.5	172.0	103.6	163.7	114.4	121.1	157.5	114.2	115.4	95.4
Machinery	105.6	102.5	87.0	114.2	110.1	84.6	83.1	55.2	100.9	90.8	67.6	100.1	107.5	117.9
Appliances	86.8	69.3	85.9	53.8	41.9	47.7	60.0	75.3	85.0	58.6	69.9	84.6	95.3	91.8
Transport Equipment	190.6	217.5	183.2	158.9	179.3	137.1	108.1	70.7	116.0	126.9	94.3	114.9	116.3	132.0
Measuring, & Optical Equipment	147.3	156.3	184.1	106.5	111.4	119.3	94.5	125.5	106.5	107.2	123.9	106.0	112.4	98.2
Other Manufacturing	60.4	45.9	56.3	46.5	34.6	39.0	51.8	66.2	75.4	49.0	58.1	73.7	90.7	83.9
Electricity, & Gas	162.9	255.0	339.5	216.1	337.5	406.8	88.9	80.5	106.1	108.4	106.4	66.4	112.3	157.6
Construction	63.4	53.2	72.4	86.0	72.1	89.0	59.9	98.8	77.7	58.5	79.0	77.5	95.4	79.7
Wholesales, & Retail Trade	97.5	104.1	98.6	142.2	152.7	130.8	104.7	134.0	100.7	105.6	111.7	114.0	112.3	78.9
Transportation, & Communication	139.3	174.7	180.1	139.3	173.2	162.0	100.7	111.3	104.8	113.8	117.9	94.2	113.1	100.7
Financing, & Business Services	104.7	121.4	156.4	146.8	170.2	198.5	122.9	101.1	102.2	121.0	112.7	125.6	115.4	171.9
Community, & Social Services	96.2	112.0	122.0	138.8	162.1	159.6	77.9	94.0	107.8	121.2	123.2	79.1	112.5	96.4
Column	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)	(25)	(26)

whose wages are higher. As a result, output of heavy manufacturing sectors, such as primary metal as well as transport equipment and services increases(see Col.(21)in Table 5;*e.g.*,a 7.8% increase for primary metal, 16% increase for transport equipment, and 7.8% increase for services) while output of light manufacturing decreases(*e.g.*,11.9% decrease for food, 9.6% for beverages, and an 8.2% decrease for tobacco). When capital is mobile but distrortions are still present, the output of light manufacturing sectors declines further as reduced quantities of labor(caused by migration)dampen the marginal product of capital, which, in turn, reduces capital stock in these sectors(see Col. (22)in Table 5; *e.g.*, a 32.2% decrease in output for food, 37.3% decrease for beverage, and 36.4% decrease for tobacco).

It is interesting to note that when distortions in the capital market are also removed, however, the structural change occurs in the opposite direction. This time, the heavy manufacturing sectors contract while light manufacturing sectors expand (see Col. (23)in Table 5; expecially, a 50.2% output reduction for primary metal, 32.4% reduction for machinery, and 5.7% reduction for transport equipment as compared to a 55.8% output increase for beverages, a 10.6% increase for tobacco, and a 29.2% increase for leather). This happens because capital now migrates out of heavy manufacturing sectors, including machinery, whose returns on capital are low compared to light manufacturing. Capital stocks migrate into labor-intensive(or less capital-intensive) light manufacturing sectors where they earn higher returns.

When capital is mobile but distortions maintained (*e.g.*,in Col. (19) and (25) in Table 5), *decreases* in returns to capital due to outmigration of labor occurs hand in hand with the reduction of capital stock in the same sector (*e.g.*,33.6% reduction in capital for food, a 35.8% reduction for beverages, a 35.3% reduction for tobacco, and a 48.8% reduction for textiles). On the other hand, an increase in returns on capital indicates reduction of capital when distortions are removed in the capital market (see Col. (20) and (26);*e.g.*,a 63.7% reduction of capital for primary metal, a 44.8% reduction for machinery, and a 29.3% reduction for transport equipment).

Another interesting result in Table 5 in that, when distortions are removed in the capital market, capital seems to be the determining factor in deciding the direction in which reallocation of resources takes place, especially in heavy manufacturing (see primary metal and machinery in Col. (18) and (20) in Table 5).[11] In the case of non-traded goods, the price adjustment in dampened when capital is mobile (*e.g.*,in Col. (1) and (2) of Table 5 the net price(or value-added)of business sector increases by 16.8% instead of 22.8%) because increases in factor mobility

[11]For example, if capital market distortions are removed from primary metal and machinery, the outmigration of capital from these sectors is followed by concurrent outmigration of labor, but not the other way around.

reduces excess demand, which in turn reduces price adjustment required to eliminate that excess demand. When distortions are removed in the capital market, however, the price adjustment increases (to 53.9% in Col. (3) in Table 5) in the same sector, because consumption of the non-traded good is more heavily affected by the removal of distortions.

IV. DYNAMIC CONSEQUENCES OF CAPITAL MARKET DISTORITIONS

Intertemporal simulations were conducted to investigate the effects of capital market distortions on capital formation in manufacturing during the year that follows the base year (1978). This exercise is confined only to the manufacturing sector, because the inefficiency argument in Korea has centered primarily on differentials in lending rates and tax subsidies between heavy and light manufacturing sectors. [12] It is assumed that producers decide on how much fixed investment to undertake in a given period based on their expectations of sales, factor prices, and the rate of inflation in the next period. We make use of the model developed by Adelman and Robinson(1978) in computing sectoral investment for the year 1979. Actual data for 1979 is used to generate expectations of the key variables to estimate the capital growth of the economy under four different policy regimes: the case with only the financial incentives; the case with only the fiscal incentives; and the last with both financial and fiscal incentives. This exercise in intended to help us understand how capital market distortions engineered by the government have affected investment.

First of all, sectoral rental prices are computed using the scheme described in appendix B. The sectoral average borrowing rates (r_{ai} in equation 12 in appendix B) are calculated as a weighted average of the lending rate on policy-directed loans (*i.e.,* 7.5% on export and foreign loans) and the curb-market interest rate. The sectoral average borrowing rates are used for the computation of the sectoral rental prices (Hall and Jorgenson, 1967). The computation of rental price with both incentives (financial and fiscal) suggests that primary metal sector faced the lowest rental price of 7.8%. The machinery and transportation equipment sectors also show low rental prices of 13.2% and 13.3%, respectively. These are followed by the chemical sector with the rental price of 22%, refiecting tax subsidies. In contrast, the beverage, printing, and leather sectors show relatively high rental prices (31.7, 37.2 and 26.6%, respectively).

The next step in the dynamic simulation is to examine the effects of capital market distortions on firms' investments. When there is no incentives at all (neither financial nor fiscal), each sector faces the same borrowing cost (*i.e.,* setting all θ_1's, and θ_2's in Equation 12 in appendix B equal to 0.5) along with no tax incen-

[12] See Choi and Kwack (1990) for further details on the incentive tax system in Korea.

[**Table 6.**] Growth Rate of Gross Capital Stock for Manufacturing, 1979
(all figures are percentage changes)

	Reference Case No Incentive	Financial Incentives Only	Fiscal Incentives Only	Both Incentives
Growth Rate of Gross Capital Stock	3.1	6.8	11.6	15.8

[**Table 7.**] Changes in Sectoral Capital Stock Under Alternative Incentive Scheme
(all figures represent percentage changes from capital stock in reference case.)

	Reference Case No Incentive[a]	Financial Incentives Only	Fiscal Incentives Only	Both Incentives
Food	95.0	90.1	105.1	94.7
Beverage	123.6	94.5	101.3	95.7
Tobacco	108.0	97.9	100.9	98.9
Textiles	91.0	94.0	105.8	99.5
Leather	190.6	93.2	105.8	98.6
Wood & Furniture	105.0	118.5	105.8	125.5
Paper Product	96.8	88.8	105.6	93.8
Printing	46.7	72.0	108.2	77.9
Chemicals	121.9	96.1	110.5	106.3
Petroleum Refineries & Petroleum Products	102.9	94.4	104.0	98.2
Rubber Products	86.5	101.8	117.2	119.3
Nonmetal	90.9	111.8	112.2	125.5
Primary Metal	97.0	131.6	107.4	141.4
Fabricated Metal	113.0	82.0	114.4	93.8
Machinery	120.5	120.2	111.5	134.1
Appliances	150.3	95.9	108.6	104.2
Transport Equipment	100.0	122.8	113.1	139.0
Measuring, & Optical Equipment	115.6	100.8	106.5	107.4
Other Manufacturing	104.4	106.3	105.2	111.9

[a]Figures represent percentage changes from the base year capital stock

tives (*i.e.*, z_i is 0). In other words, all sectors face the same rental price of capital. Only when financial incentives are considered, does each sector face different borrowing costs (θ_2 is computed from $RFETB_i$ in equation 13 in appendix B) with z_i set equal to 0. In the case of fiscal incentives only, each sector faces a uniform borrowing cost, but with different tax subsidies, and hence different rental prices. Finally, "both incentives" refers to the case when financial and fiscal incentives are present. The results of our experiments are summarized in Table 6 which suggests that gross capital stock for manufacturing would grow by 3.1% in the case of no incentives, by 6.8% with only financial incentives, by 11.6% with only fiscal incentives, and by 15.8% with both incentives. Table 7 shows percentage changes in sectoral gross capital stock from the base-year capital stock under an alternative incentive scheme. The first column, the reference case, shows what would have happened to capital stock in manufacturing if there had been no incentive, in which case capital stock would have grown faster in light manufacturing (*e.g.,* beverages, and leather).[13] Note also that only when the financial incentives are present, capital stock concentrates more heavily in primary metal, machinery, and transport equipment. On the other hand, if only the fiscal incentives are used, concentration is mild. With both incentives capital concentration in these three sectors in further accentuated. These results clearly suggest that financial incentives had more distorting effects than fiscal incentives. Table 6 and 7 also suggest that capital market distortions in Korea may have influenced capital formation in two ways: first by raising the growth rate of capital and second, by affecting the sectoral distribution (or concentration) of capital. Caveat! One should not conclude from this result that financial subsidies are necessarily more powerful than the fiscal subsidies. Our results merely reflect a unique configuration of two types of subsidies in Korea, where the financial subsidies were the most dominate mode of subsidies.

V. CONCLUSION

This study incorporates three innovations over previous analyses of efficiency losses arising from factor market distortions: first, autonomous differentials are distinguished from distortions; second, distortions are removed not only from the labor market but also from the capital market within the computable general equilibrium framework; and third, dynamic consequences of distortions are examined given three alternative policies, namely, financial incentives, fiscal incentives, and a combination of the two.

The major finding of the study is two-folds. First, the welfare effects of removing factor price distortions are minimal, which is consistent with the small welfare losses obtained by Dougherty and Selowsky (1973) for Colombia, and Fiϕystad (1975) for Norway, among many others. Insensitivity of the welfare indices to allocative inefficiency implies that the static first order condition are of a little relevance. Second, from a dynamic standpoint, capital market distortions may lead to a more rapid accumulation of capital stock and a higher capital concentration in certain sectors that are subsidized. These results combined cast doubts on the importance of the efficiency loss argument associated with factor price distortions.

[13]Capital stock in machinery grows fast even in the absence of incentives, because the sector's gross output, as a proxy for expected sales, grew at a higher rate.

At the same time, the study sheds some light on the question of how the Korean economy has managed to grow rapidly in spite of factor market distortions. It lends support, albeit indirectly, to the view, that dynamic efficiency gains (*i.e.*, from x-efficiency, the spread of new technological knowledge, and so forth), resulting from larger and more concentrated capital stock, especially in the export-oriented environment, may have more than offset the allocative inefficiency.[14]

[14]See Harberger (1959), Leibenstein (1966), and Kwon (1986 and 1990).

APPENDIX

A. Model Summary

		Number of Equations
1) Production		
$x_i = \min(\bar{A}_i K_i^{\alpha i} L_{1i}^{\beta 1i} \ldots L_{ji}^{\beta ji},\ a_{ji}x_j)$	$i,j = 1 \ldots n$	n
2) Factor demand		
$L_{si} = \frac{\beta_{si}P_i^*}{W_{si}} X_i;\ W_{si} = \phi_{si}W_s$	$i = 1 \ldots n$	sn
$K_i = \frac{\alpha_i P_i^*}{r_i} x_i;\ r_i = \varepsilon_i r;\ \varepsilon_i = d_i E_i^*$	$i = 1 \ldots n$	n
3) Factor endowment		
$\Sigma_{i=1}^{n} L_{si} = L_s$		s
$\Sigma_{i=1}^{n} K_i = \bar{K}$		1
4) Rural-Urban Wage Differential		
$RU_s^1 = RU_s^o$		s
where $RU_s = \frac{W_{si}\ \Sigma_j\ L_{sj}}{\Sigma_j\ W_{sj}\ L_{sj}}$	$j = 2 \ldots n$	
5) Net price equations		
$P_i^* = P_i - \Sigma_{j=1}^{n} a_{ji}P_j - \sigma_i P_i - a_{oi}P_o$	$i = 1 \ldots n$	n
6) Consumption equations		
$P_j c_i = P_i \delta + \gamma_i(y - \Sigma_{j=1}^{n} P_j \delta_j)$	$i = 1 \ldots n\text{-}1$	n—1
7) Material balance equations		
$x_k = \Sigma_j\ a_{kj}x_j + c_k + Z_k + G_k + T_k + a_{oi}x_i$	$k = 1 \ldots q_1$	q_1
$x_l = \Sigma_j\ a_{lj}x_j + c_l + Z_l + G_l + a_{oi}x_i$	$l = q_1 + 1 \ldots n$	q_2
8) Balance of payment equations		
$\Sigma_{k=1}^{q1} \pi_k T_k - \pi_o\ \Sigma_i a_{oi}x_i = \Delta$		1
9) Normalization Rule		
$\Sigma_{i=1}^{n} P_i^{*1}\ x_i^o = \Sigma_{i=1}^{n} P_i^{*o}\ x_i^o$		1
		$(s = 1 \ldots 5)$

List of Variables and Parameters

x_i	Gross output of sector *i*
c_i	Private consumption for good *i*
T_k	Quantity traded of good *k*
P_i, P^*_i	Domestic and net price of output for sector *i*
w_s	Average wage of type labor
r	Average rate of return on capital
L_{si}	Type *s* Labor in sector *i*
K_i	Capital stock in sector *i*
a_{ij}, a_{oi}	Input-output coefficient and non-competitive import of sector *i*
ϕ_{si}, ε_i	Differential return scale parameter for type labor and capital
ε^*_i	Distortion-free factor scale parameter for capital in sector *i*
d_i	Distortion parameter in sector *i*
σ_i	Indirect business tax
γ_i, δ_i	Marginal expenditure share and subsistence minimum for sector *i*
y	Total private expenditures
$\bar{Z}$	Investment demand by sector of origin
$\bar{G}$	Government expenditures
Δ	Trade Gap

Including the equations linking domestic to world prices, there are $(5n+sn+2s+q_1+2)$ equations to determine the following same number of endogenous variables: x_i, c_i, P_i, P^*_i, K_i, L_{si}, r, w_s, RU_s, T_i *and* Δ

The assumption of decreasing returns to scale of 0.9 for all sectors (see De Melo, 1977, p. 400)were kept to prevent the complete specialization problem discussed in Samuelson (1953). However, some parameters were recomputed to reflect constant returns to scale suitable for dynamic process (see adelman and Robinson, 1978).

B. Dynamic Process

This process determines firms' demand for fixed investment. For a given output, the problem is cost-minimization. First-order conditions for cost minimization are:

10) $$MC_i = \frac{w_{si}L_{si}}{\beta_{si}x_i} \qquad \text{si equations}$$

and

$$MC_i = \frac{r_iK_i}{\alpha_i x_i} \qquad \text{i equations}$$

where MC_i is marginal cost for firms in sector i, w_i is the wage rate of type s labor employed in sector i, and r_i is the rate of return on capital stock in sector i. Given the production function(s) for the base year and the target output, these conditions make up $s+2$ equations to be solved for K_i, L_{si} and MC_i for each sector i. We take K_i as firms' desired capital stock for the next period.

r_i in Equation 10) is computed as follows:

11) $r_i = (r_{ai} + D - \pi^e)(1\text{-}z_i)\ P_i^c$

where r_i is the rental price of capital, r_{ai} the average borrowing rate facing firms in sector i, D, the economic depreciation rate, z_i, tax-subsidies, π^e, the expected rate of inflation, and P_i^c, the unit price of capital stock in sector i. The average borrowing rate for each sector is computed as follows:

12) $r_{ai} = \theta_1 i^B + \theta_2 i^C$ with $\theta_1 + \theta_2 = 1$

where i^B and i^C denote interest rates on policy-directed loans from the official banking sector and the curb market rate, respectively, and θ_1 and θ_2 are the respective weights of these two rates. These weights depend on the relative financial cost ratios($RFETB_i$) in the following manner:

13) If $RFETB_i = RFETB_{min}$, $\theta_2 = 0$ so that $r_{ai} = i^B$,
If $RFETB_i = RFETB_{max}$ $\theta_1 = 0$ so that $r_{ai} = i^C$,
If $RFETB_{min} < RFETB_i < RFETB_{max}$, $r_{ai} = \theta_1 i^B + \theta_2 i^C$.
where

$$\theta_2 = \frac{RFETB_i - RFETB_{min}}{RFETB_{max} - RFETB_{min}}$$

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