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PRICE AND TRADE LIBERALIZATION IN EAST EUROPEAN ECONOMIES

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ABSTRACT

This paper analyzes the structural impact of a comprehensive price and trade liberalization in the East European economies using a three-sector three-factor general equilibrium small open economy model developed here. Also, it studies the impact of foreign aid, and illustrates the results quantitatively via simulation exercises. In the short run, the liberalization generates a significant structural shift in employment and production from manufacturing to the non-tradables, and may worsen or improve the real wage. In the long run, the structural shift is twice as large, and the real wage drops significantly while the returns to land and capital rise. The material input sector expands, and the national capital stock falls. Foreign aid, whose impact is noticeable only when it is in excess of 2% of GNP, exacerbates the structural shift, and may improve the real wage in the short run but has no impact on factor returns in the long run.

KEY WORDS: **Liberalization, Structural Adjustment, East European Economies, Transition Economics**

1. INTRODUCTION

With the downfall of the East European communist regimes in 1989, these countries have attempted to transform their centrally planned economies into market economies by, among others, liberalizing prices and foreign trade. Consequently, their production structures, which were skewed towards the "high-price" or "priority" manufacturing sector,[1] have been changing.

The existing studies on these transitional economies have generally focused on the macro effects of such reforms,[2] and have primarily addressed the initial inflation (stagflation) outcome of the liberalization (e.g., Calvo and Coricelli (1992), Cochrane and Ickes (1991), Commander (1992), Commander and Coricelli (1992), Dornbusch (1992), Lipton and Sachs (1990a, 1990b), and Naughton (1991)). One exception to this focus is McKinnon (1991) which addresses the impact on the manufacturing industries of the alignment of domestic material prices with the respective world prices. But, material prices are not the only prices changed by the liberalization. The "irrationally"[3] high price of "priority" manufactured goods declines, and the "irrationally" low price of "non-priority" services and goods rises as well.[4]

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[1] Some industries were built and maintained at negative value added at international prices, as McKinnon (1991) points out.

[2] This focus stems from the central role of macro stability at the initial stage of the transition.

[3] The terms "irrational" and "highly distorted" have been widely used to describe the centrally planned price structure which, in particular, served to extract savings for the purpose of rapid growth.

[4] Under the centrally planned price system, prices for "basic" goods and services such as agricultural products, raw materials, housing, transportation, public utilities and other services were set "irrationally" low. Prices for "modern" or manufactured goods such as machinery and tools, electronics and chemical products were set "irrationally" high.

This paper analyzes the short-run and long-run structural impact of a comprehensive price and trade liberalization in the East European economies. It considers not only the rise in the price of material inputs, but also the decline in the price of the tradable manufactured goods and the rise in the price of the non-tradable services and goods. It studies mainly the impact of the liberalization on the sectoral employments and outputs and the real wage. It considers the impact of foreign aid on the results as well. It provides quantitative illustrations to all the theoretical results via simulation exercises. It addresses the structural consequences of the "often-debated" complete price and trade liberalization in the East European economies, and the impact on these consequences of the "often-recommended" foreign aid.

The short-run and long-run analyses are conducted with a three-sector three-factor general equilibrium small open economy (SOE) model developed here.[5] The distinction between the short-run and long-run models is mainly on the production side. The short-run model, which is of the Jones specific-factors type, considers capital to be sector specific (and fixed) and land and labor to be non-substitutable. The long-run model imposes no restrictions on the mobility or substitutability of factors of production. In addition, it incorporates a capital rental based on world prices.[6] On the demand side, the inherited

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[5] In effect, we consider two different models and the labelling of them as short- and long-run analyses stems from their respective sets of assumptions being associated with "short run" and "long run".

[6] Neary and Purvis (1983) also do this but from a financial market perspective, Fardmanesh (1990), on the other hand, does this from a real-side perspective similar to the one here.

shortage in the non-tradable good market is explicitly modelled.[7] This shortage, which drives up the price of the non-tradable goods and services and their production, plays an important role in the analysis.

The characteristics of the model are described in the next section. The short-run and long-run impact of the liberalization are analyzed in section 3 and section 4. Concluding remarks are provided in section 5. Certain definitions and derivations are presented in Appendix I, while the choice of parameter values for simulations and sensitivity tests are discussed in Appendix II.

2. THE MODEL

Consider a 'small' open economy which produces three distinct commodities: a tradable material input (basics, B), a tradable final good (manufacturing, M), and a non-tradable final good (services, N). The three goods are normal in the aggregate; M is an investment good as well as a consumption good.

The three sectors follow a constant returns to scale CES production process. The material input (B) is produced with labor and land. The two final goods (M and N) are produced with labor, capital and material input. Both M and N are produced with two-level CES production functions, where weak separability is assumed. M and N are linearly homogenous in value added (V) and material input (B); and V, in turn, is linearly homogenous in labor (L) and capital(K). In the short run, labor and land are not

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[7] Chronic shortages associated with the "low-price" or "non-priority" material inputs sector and services sector became such a steadfast feature of all planned economies that Kornai's (1980) "shortage economy" has stood as another name for these economies.

substitutable and the domestic production of material input is uniquely determined by the full utilization of land and is fixed.[8] In the long run, labor and land are substitutable and the domestic production of B is endogenously determined. The endowments of labor and land are fixed both in the short run and long run. Capital is sector-specific and fixed in the short run, but is mobile between sectors and can expand or contract in the long run. It is all domestically owned, and has a zero rate of depreciation.[9]

The demand for the two final goods is a function of their (relative) prices and (real) income.[10] In order to capture the most important characteristic of the former socialist economies or the "shortage economies", the inherited shortage in the non-tradable goods market is explicitly modelled. The shortage, represented as a percentage of the equilibrium N, plays an important role in the analysis.

The price liberalization abolishes the rationing schemes, and the trade liberalization links the economy with the world markets. The price of N rises to eliminate the shortage in the respective market, and the price of B rises to its world level. The price of M adjusts downwards to its world level. The prices of N and B rise relative to that of M. Following these two relative price changes, the economy adjusts to a new market-determined equilibrium from the old centrally-planned (dis)equilibrium.

The short-run and long-run impact of the liberalization in the three sectors are

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[8] Hence, the return to land is residually determined by the world price of B and the domestic wage rate. Assuming a fixed endowment of B is an alternative without such a restriction.

[9] This simplifies our calculations without changing the results.

[10] Corden and Neary (1982) and Fardmanesh (1990) also model demand in this way.

addressed by studying the respective market equilibrium conditions. The (non-tradable) good and factor markets clear and profits are zero. The distinction between the tradable and non-tradable goods is essential here, as in Dutch Disease analyses. Domestic demand for and supply of the non-tradable good N must equal. By contrast, the domestic demands for and supplies of the two tradable goods B and M need not equal. However, the overall trade must be balanced, as the trade balance is assumed exogenous and set at zero.[11]

As in all SOE models, the prices of the two tradable goods B and M are determined in the respective world markets, while the equilibrium in the domestic market for N determines its price. The price of M equals one by the choice of numeraire; and a proportional rate of change is denoted by a circumflex (^), e.g., $\hat{x}=dx/x$.

3. THE SHORT-RUN ANALYSIS

A. THE THEORETICAL ANALYSIS

With land and labor not substitutable in the short run, the domestic production of material input is uniquely determined by full utilization of land and is fixed. The production of M and N are determined endogenously as follows.

The profit-maximization conditions are described by:

$$a_{LM}W+a_{KM}R_M+a_{BM}\pi=P_M \qquad (S.1)$$

[11] This assumption may seem restrictive for our short-run analysis. However, allowing for a trade imbalance (deficit) in the short run even when granting it an impact on consumption only exacerbate the impact of the inherited shortage and leaves the respective results qualitatively intact.

$$a_{LN}W+a_{KN}R_N+a_{BN}\pi=P_N \qquad (S.2)$$

where a_{ij} is the quantity of factor i (i=L,K,B) required to produce a unit of commodity j (j=M,N), W is the return to labor, R_M and R_N are the returns to capital in sectors M and N, and P_M, P_N and π are the prices of M, N and B, respectively. P_M equals one by the choice of numeraire.

The full-employment (factor market) conditions are described by:[12]

$$a_{KM}M=K_M \qquad (S.3)$$

$$a_{KN}N=K_N \qquad (S.4)$$

$$a_{BM}M+a_{BN}N=B \qquad (S.5)$$

$$a_{LM}M+a_{LN}N=L \qquad (S.6)$$

where K_j is the (fixed) capital stock in sector j (j=M,N), B is the material input used by the entire economy, L is the (fixed) labor force available to sectors M and N.

The market clearing condition for goods (N) is described by:[13]

$$\hat{N}=\hat{N}^d(P_N,Y)+\hat{J} \qquad (S.7)$$

where N and N^d represent the supply of and demand for the non-tradable good, J is the inherited shortage for N represented as a percentage of the equilibrium N, and national

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[12] In all equations M and N denote the supply of the respective two goods.

[13] This arises from the pre- and post-liberalization market conditions of $N_{pre}+J=N^d_{pre}$ and $N_{post}=N^d_{post}$ which indicate a shortage of J units initially.

income, Y,[14] is:

$$Y=M+P_N N-\pi(B-B_H) \qquad (S.8)$$

where B_H is the domestic production of material input, which is fixed in the short run. The term $\pi(B-B_H)$ is the net import of the material input.

The short-run impacts of the liberalization are derived parametrically from the above conditions.[15] In all cases, the first term on the right-hand side captures the impact of the rise in the (relative) price of material input denoted by $\hat{\pi}$. The second term captures the impact of the inherited shortage for N denoted by $\hat{J}$.

The impact on the price of the non-tradable good, on the overall price level, on the wage rate, all measured in units of M, and the real wage are represented by:

$$\hat{P}_N=\frac{n_2+\gamma_2}{n_1-\gamma_1}\hat{\pi}+\frac{1}{n_1-\gamma_1}\hat{J} \qquad (S.9)$$

$$\hat{P}=\frac{\phi_N n_2+\phi_N\gamma_2}{n_1-\gamma_1}\hat{\pi}+\frac{\phi_N}{n_1-\gamma_1}\hat{J} \qquad (S.10)$$

$$\hat{W}=(\frac{b_1 n_2+b_1\gamma_2}{n_1-\gamma_1}-b_2)\hat{\pi}+\frac{b_1}{n_1-\gamma_1}\hat{J} \qquad (S.11)$$

$$(\frac{\hat{W}}{P})=(\frac{b_1 n_2-\phi_N n_2+b_1\gamma_2-\phi_N\gamma_2}{n_1-\gamma_1}-b_2)\hat{\pi}+\frac{b_1-\phi_N}{n_1-\gamma_1}\hat{J} \qquad (S.12)$$

The liberalization ($\hat{\pi}>0$ & $\hat{J}>0$) expectably raises the price of the non-tradables in the

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[14] Considering Y, gross domestic product, as national income assumes that net foreign earnings as well as capital depreciation are zero.

[15] See Appendix I.

short run. The inherited shortage for N raises P_N, but the rise in the material price has an ambiguous effect on it. The increase in π discourages the production of N and, hence, raises P_N. Yet the decline in the national income resulting from the lower production of N (and M) reduces the demand for N and, hence, reduces P_N. But the direct positive impact of the significant shortage and the higher material cost plausibly dominates the indirect negative secondary impact of the higher material price through the national income channel. Given P_N rises, the liberalization also raises the overall price level,[16] P, in the short run. With the price of the manufactured good being the numeraire, the increase in P is proportional to that in P_N.[17]

The liberalization expectably raises the wage rate in the short run as well.[18] The change in W is positively related to the increase in P_N caused by the shortage, and is negatively related to that in π. For a given employment, an increase in P_N raises the marginal revenue product of labor in general and, hence, increases the return to labor. Yet, an increase in π, like technical regress, depresses the return to labor (and capital), for given commodity prices.[19] But, the positive impact of the large shortage plausibly dominates the negative secondary impact of the rise in the material input price.

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[16] The reason for considering this variable here is to separate the impact of the liberalization on the real wage via the goods prices. Otherwise, the concept of "overall price level" has no role to play in our real-side analysis.

[17] The expenditure share of good N is the proportion factor.

[18] It should be noted that the liberalization can be inflationary because it exerts upward pressure on the overall price level and the wage rate.

[19] As Bruno and Sachs (1982) demonstrates, an increase in the material input price shifts the factor price frontier inward in the W-R space and depresses the payment to labor and capital.

The impact on the real wage or on the welfare of a representative worker is ambiguous, given both P and W increase. It depends, among others, on their consumption pattern, or the spending shares of M and N. If they spend a large (small) share of their income on the non-tradables (tradeables), as is the case in the East European countries, their real wage could fall, and vice versa.

The impact on the employment in sectors M and N are represented by:

$$\hat{L}_M=(-\frac{f_1(n_2+\gamma_2)}{n_1-\gamma_1}-f_2)\hat{\pi}-\frac{f_1}{n_1-\gamma_1}\hat{J} \qquad (S.13)$$

$$\hat{L}_N=(\frac{h_1(n_2+\gamma_2)}{n_1-\gamma_1}-h_2)\hat{\pi}+\frac{h_1}{n_1-\gamma_1}\hat{J} \qquad (S.14)$$

The liberalization reallocates labor from sector M into sector N. The shortage lowers the employment in sector M and raises that in sector N, as labor is reallocated to meet the existing excess demand for N. It raises the real product wage in sector M and lowers that in sector N. The rise in the material price has an ambiguous but secondary impact on the employment in sectors M and N. It affects the employment in both sectors negatively by increasing their respective real product return to material. On the other hand, it affects the employment in both sectors positively by lowering their respective real product wage.[20] The employment in sector N rises and that in sector M falls as the definite employment effect of the significant shortage dominates the secondary ambiguous employment effect of

[20] Regarding sector N, this assumes that the impact of the higher material cost on W plausibly dominates that on P_N. For this to hold a sufficient but not necessary condition is that the direct positive impact of the higher material cost on P_N via the production cost channel dominates the indirect negative one via the national income channel.

the higher material price for both sectors.

The impact on the output in sectors M and N are represented by:

$$\hat{M}=(\frac{-m_1n_2-m_1\gamma_2}{n_1-\gamma_1}-m_2)\hat{\pi}-\frac{m_1}{n_1-\gamma_1}\hat{J} \qquad (S.15)$$

$$\hat{N}=\frac{n_1\gamma_2+n_2\gamma_1}{n_1-\gamma_1}\hat{\pi}+\frac{n_1}{n_1-\gamma_1}\hat{J} \qquad (S.16)$$

The liberalization generates a significant structural shift from sector M to sector N. The output in sector M falls while that in sector N rises, given a significant shortage for N. The increase in the material input price induces firms to reduce the usage of material input and, hence, exerts a negative impact on output in both sectors. We call this impact the "material input effect". The shortage raises the price of N relative to that of M and, hence, reduces the real product wage in sector N relative to that in sector M. Thus, sector M loses labor to sector N. We call this impact the "employment effect". Sector M experiences a negative material input effect and a negative employment effect, and unambiguously contracts. Sector N experiences a negative material input effect but a positive employment effect. As the positive employment effect of the large inherited shortage plausibly dominates the secondary negative material input effect, sector N expands.

It should be noted that the domestic output of M is determined solely on the supply side, as M is a tradable good. By contrast, the demand for N plays an important role in determining its output. The inherited shortage for N raises its price and, hence, its production. However, the final increase in the output of N is smaller than the initial excess demand for it. The simultaneous rise in the prices of N and B eliminates part of the initial

shortage.[21] The higher price for N discourages the demand for it through the own-price channel. The higher material input price depresses the demand for N through the national income channel, since it reduces economy-wide production/income.

The qualitative impact of foreign aid on the above results are as follows.[22] In general, it exacerbates the impact of the shortage.

Regarding the prices and wages, foreign aid raises the demand for all goods via higher income. Part of the increase in spending falls on the non-tradable good and, hence, raises its price.[23] This in turn increases the overall price level. The resulting expansion in the production of N exerts upward pressure on the wage rate. The real wage or the welfare of a representative worker improves if the shortage raises the real wage, and vice versa.[24]

Regarding the sectoral employment and output, foreign aid raises the real product wage in sector M and lowers that in sector N by increasing the price of N. It reallocates

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[21] As indicated by equation (B.10) in Appendix I.

[22] The exact impact can be obtained parametrically by (re)conducting the short-run analysis with a new national income equation inclusive of the aid as follows:

$$Y_{aid}=M_{aid}+P_{Naid}N_{aid}-\pi(B_{aid}-B_H)+T$$

where T denotes the aid measured in units of M.

[23] The change in the price of N now becomes:

$$\hat{P}_{N_{aid}}=\hat{P}_N+\frac{\eta_N\phi_T}{n_1-\gamma_1}\hat{T}$$

Since $n_1-\gamma_1>0$, the coefficient of $\hat{T}$ is positive.

[24] This is more likely, the larger are the employment and output shares of sector N and the elasticity of substitution between L and K in this sector, and the smaller are the income elasticity of demand for N and the expenditure share of N.

labor from sector M to sector N and, hence, shifts the production from sector M to sector N.[25] It expands sector N at the expense of sector M.[26]

B. THE SIMULATION ANALYSIS

The short-run impact of the price and trade liberalization are explored quantitatively via three simulation exercises. In simulation 1, we consider both the misalignment in the price of the tradable goods and the shortage for the non-tradable goods. In simulation 2, we suppress the former and study the impact of the latter alone. In simulation 3, we do the opposite. This also allows us to assess their relative significance.

The increase in the domestic price of the material input required to align it with the respective world price is set at 30%, while the inherited shortage for N is set at 50% of its equilibrium amount ($\hat{\pi}$=30% and $\hat{J}$=50%). The structural parameters of the economy are set at values presented in Table 1. The short-run simulation results are summarized in Table 2. The results are stable: varying the parameter values within realistic ranges does not alter them qualitatively.[27]

Regarding the prices and wages, simulation 1 shows that the price of the non-tradable good and the overall price level rise significantly (by 35% and 17% respectively),

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[25] The changes in the output of M and N are now described by:

$$\hat{M}_{aid}=\hat{M}-\frac{m_1\eta_N\phi_T}{n_1-\gamma_1}\hat{T}, \qquad \hat{N}_{aid}=\hat{N}+\frac{n_1\eta_N\phi_T}{n_1-\gamma_1}\hat{T}$$

where the coefficient of $\hat{T}$ is positive in both cases.

[26] This is known as the "Spending Effect" in the Dutch Disease analysis.

[27] Only, and expectedly, the real wage shows some sensitivity; see Appendix II.

with the rise in P_N being almost twice that in P.[28] The wage rate would go up by a large amount (by 16%), but the real wage would fall by a very small amount (by 1%).[29] Simulations 2 and 3 reveal that the shortage is by and large the source of these changes. The rise in the material price has an insignificant negative effect on P_N (of 2%) and, hence, on P (of less than 1%).[30] Even its more significant negative effect on W (of 8%) is only a third of the positive effect of the shortage on W. Its similar negative effect on W/P (of 7%) offsets the positive effect of the shortage on W/P (of 6%), however. It should be noted that the real wage would decline significantly where the rise in the material input price is large and the spending share of N is large.

Regarding the sectoral employment and output, simulation 1 shows that they rise significantly in sector N (by 23% and 20% respectively) and fall even by larger amounts in sector M (29% and 25% respectively). These changes can all be attributed to the shortage alone because the effect of the material price rise is negligible (not more than 0.5%) in all cases, as shown by simulations 2 and 3.

As for the impact of foreign aid on the above results, simulation exercises show that the aid has to be large in order to have an effect. Foreign aid in the likely amounts (e.g., 0.5% or 1% of the GNP) has no noticeable impact.[31] Only when it is more than 2% of the

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[28] This is due to the expenditure share of N being about one half here.

[29] As discussed in Appendix II, the real wage may rise by a small amount instead.

[30] This implies that here the rise in π discourages the demand for N more than the supply of N.

[31] The sectoral employment and output impact is less than 1%.

GNP,[32] it will have some effect. When it is raised to 5% of the GNP, compared with the "no-aid" case, for example, and the price of the non-tradable good would increase 5% more. The production of M would fall by 2% more, while the production of N would rise by 3% more.

4. THE LONG-RUN ANALYSIS

A. THE THEORETICAL ANALYSIS

With land and labor substitutable in the long run, sector B is now explicitly modelled and the domestic production of material input is determined endogenously along with those of manufacturing and non-tradable good as follows.

The profit-maximization conditions now become

$$a_{LB}W+a_{AB}V=\pi \qquad (L.1)$$

$$a_{LM}W+a_{KM}R+a_{BM}\pi=P_M \qquad (L.2)$$

$$a_{LN}W+a_{KN}R+a_{BN}\pi=P_N \qquad (L.3)$$

where V is the return to land and R is the economy-wide return to capital, and a_{ij} is the quantity of factor i (i=L,K,A,B) required to produce a unit of commodity j (j=M,N,B). As before, W is the return to labor, P_M, P_N and π are the prices of M, N and B, respectively, and P_M equals one by the choice of numeraire.

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[32] This assumes that the aid is raised from .5% of GNP to 2.5% of GNP, or alternatively from 1% of GNP to 3% of GNP. The sizes of both the pre- and post-liberalization aid matter because of the rate-of-change form of the analysis.

Since the manufactured output is the capital good as well and the domestic interest rate equals the world interest rate in the long run, the capital rental (R), which had been set low under the planning system, is now determined by world prices:

$$R=P_M.r^* \qquad (L.4)$$

where r^* is the world interest rate. The marginal revenue product of capital (R) equals the opportunity cost of capital usage ($P_M.r^*$) in the long run.

The factor market equilibrium conditions become

$$a_{AB}B_H=A \qquad (L.5)$$

$$a_{KM}M+a_{KN}N=K \qquad (L.6)$$

$$a_{BM}M+a_{BN}N=B \qquad (L.7)$$

$$a_{LM}M+a_{LN}N+a_{LB}B_H=L \qquad (L.8)$$

where A is the land endowment, K is the long-run capital stock, and L is the labor endowment. As before, B is the total amount of material usage in the economy, and B_H is the domestic production of it. While A and L are exogenous and fixed, K and B are endogenous.

The goods (N) market equilibrium condition remains the same as in the short run (S.7). But, the domestic production of material input is no longer fixed in the related national income equation (S.8).

The long-run impact of the liberalization can be derived parametrically from the

above conditions.[33]

The impact on commodity prices and factor returns, which are now uniquely determined by world prices,[34] are described by:

$$\hat{P}_N = p_1\hat{R} + p_2\hat{\pi} \qquad (L.9)$$

$$\hat{P} = \phi_{N1}p_1\hat{R} + \phi_{N1}p_2\hat{\pi} \qquad (L.10)$$

$$\hat{W} = -w_1\hat{R} - w_2\hat{\pi} \qquad (L.11)$$

$$\hat{V} = v_1\hat{R} + v_2\hat{\pi} \qquad (L.12)$$

$$(\frac{\hat{W}}{P}) = -(w_1 + \phi_{N1}p_1)\hat{R} - (w_2 + \phi_{N1}p_2)\hat{\pi} \qquad (L.13)$$

The impact on the wage rate and the non-tradable good price are no longer jointly determined by the respective domestic product and factor markets. Unlike the short run, the impact on the domestic wage rate is residually determined by the world price of the material input and capital, and the price of the non-tradable good is entirely cost determined, as in Fardmanesh (1990). The shortage for N does not affect its price, but only raises the production of it.

The wage rate falls unambiguously. As both the domestic price of material input and the domestic return to capital adjust upward to their world levels, firms opt for less

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[33] See Appendix I for derivations and definitions of notations.

[34] Given (L.4), with M being the numeraire here, the percentage change (increase) in the capital rental due to the liberalization would equal the percentage change (increase) in the domestic interest rate resulting from its alignment with the world interest rate.

material-intensive and less capital-intensive technology, and the return to labor falls. The return to land rises unambiguously, for its output price (π) rises while the return to the other production factor labor falls. It rises by more than the increase in the material price.[35]

However, the impact on the price of the non-tradable good is ambiguous. The rise in the material price and in the rental cost of capital and the fall in the wage rate have opposite effects on the production cost of N. If, in terms of factor shares in unit cost, N is plausibly more labor-intensive than M while M is plausibly more material-intensive than N, P_N falls. The impact on the overall price is ambiguous, for it is proportional to the change in P_N. It falls if P_N declines.

The impact on the real wage, being the difference between the change in the wage rate and that in the overall price, is ambiguous too. Since the wage rate is falling unambiguously and the overall price is affected by offsetting effects, the real wage is likely to fall.

The impact on the sectoral employment are expressed by:[36]

$$\hat{L}_B=\frac{\sigma_B}{\theta_{AB}}[w_1\hat{R}+(1+w_2)\hat{\pi}] \qquad (L.14)$$

$$\hat{L}_M=(\frac{1}{D}m_r-c_1w_1-c_1)\hat{R}+(\frac{1}{D}m_\pi-c_1w_2+c_2)\hat{\pi}-\frac{1}{D}\lambda_{LN}\hat{J} \qquad (L.15)$$

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[35] It rises by less in the short run because the wage rate rises as well.

[36] In (L.15) the ratio in front of the bracket is the elasticity of the marginal product curve of labor in sector B; see Jones (1971).

$$\hat{L}_N=(\frac{1}{D}n_r-c_3w_1-c_3-c_4p_1)\hat{R}+(\frac{1}{D}n_\pi-c_3w_2+c_4+c_4p_2)\hat{\pi}+\frac{1}{D}\lambda_{LM}\hat{J} \qquad (L.16)$$

The employment in sector B, as is the case with the output of B,[37] solely depends on its real product wage. It rises unambiguously, for its output price increases while the wage rate falls. It is unaffected by the shortage, but is positively affected by the rise in the material and capital costs.

The employment in sector M falls and that in sector N rises, given a large shortage. The higher costs of material input and capital has an ambiguous impact on the employment in these sectors. It (and the lower wage rate) induces firms in both sectors to substitute labor for capital and material input. But, it affects employment in both sectors negatively by contracting their supply also. The shortage for N, on the other hand, induces a definite reallocation of labor from sector M into sector N. The unambiguous employment effect of a significant shortage expectably dominates the ambiguous and secondary employment effect of the rise in the material and capital costs. Thus, the employment in sector N rises and that in sector M falls.

The impact on sectoral output are described by:

$$\hat{B}_H=\theta_{LB}\frac{\sigma_B}{\theta_{AB}}[w_1\hat{R}+(1+w_2)\hat{\pi}] \qquad (L.17)$$

$$\hat{M}=\frac{1}{D}(m_r\hat{R}+m_\pi\hat{\pi}-\lambda_{LN}\hat{J}) \qquad (L.18)$$

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[37] See Appendix I.

$$\hat{N}=\frac{1}{D}(n_r\hat{R}+n_\pi\hat{\pi}+\lambda_{LM}\hat{J}) \qquad (L.19)$$

The output of B increases unambiguously, as the material price increases while the wage rate falls. Since factor price changes are determined by world prices, the change in the output of B is independent of the rest of the domestic economy. However, the output of M and N are related to each other through their joint labor supply.[38]

As for the output of M and N, the increase in the price of the material input and in the cost of capital reduces them both by raising their production cost. The shortage, while having no impact on prices, raises the output of N at the expense of that of M. The output of M falls unambiguously. The output of N rises if the shortage is sufficiently large in relation to the increase in the cost of capital and material input.

It should be noted that the contraction in sector M along with a plausible decline in the stock of capital point to a definite "De-industrialization" of the economy in the long run.[39] As for the capital stock,[40] the increases in the price of the material input and, more importantly,[41] in the cost of capital unambiguously reduce it significantly, by lowering both output and unit-capital usage in both sectors M and N. The shortage may increase the

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[38] Which is the difference between the total labor endowment of the economy and the labor employed in sector B.

[39] Since savings and investment are not considered in this analysis, we do not stress this result but only note that "Industrialization" and standard of living have been positively related in modern history.

[40] Due to space limitations, the derivations of the impact on K is not reported here.

[41] The impact of the (60%) rise in capital rental is five times that of the (30%) rise in material cost in our simulations.

capital stock somewhat if sector N uses a larger share of it,[42] as was the case on the average in our sample of the centrally planned economies. Nonetheless, given a significant contraction in sector M and a large increase in material and capital costs, the capital stock declines.[43]

The qualitative impact of foreign aid on the above results are now considered.[44] As in the short run, it reinforces the impact of the shortage on all variables considered, but its long-run impact is different in some cases.

Regarding the commodity prices and factor returns, unlike in the short run, foreign aid has no impact on them as they are uniquely determined by world prices and are unaffected by demand effects (the shortage).

Regarding the sectoral employment and output, as in the short run, foreign aid reallocates labor from sector M to sector N and, hence, shifts production from sector M to sector N.[45] The resulting rise in the demand for N causes this sectoral shift without altering the price of N, unlike the short run. Foreign aid has no impact on sector B which is

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[42] Where the opposite is the case, the shortage would have a negative impact as well, and the capital stock would fall more.

[43] The fall in capital stock is not necessarily interpreted as negative investment. If we consider population growth, the interpretation is that capital should be lower relative to its previous trend growth; see Bruno and Sachs (1985).

[44] The exact impact can be obtained parametrically by (re)conducting the long-run analysis with a new national income equation inclusive of the aid as in the short run. But, the domestic production of B is no longer fixed.

[45] The changes in the output of M and N are now described by:

$$\hat{M}_{aid}=\hat{M}-\lambda_{LN}\eta_N\phi_T\hat{T}, \qquad \hat{N}_{aid}=\hat{N}+\lambda_{LM}\eta_N\phi_T\hat{T}$$

where the coefficient of $\hat{T}$ is positive in both cases.

only affected by world prices.

B. THE SIMULATION ANALYSIS

The long-run impact of the price and trade liberalization are explored quantitatively via three simulation exercises, as in the short run. In simulation 1, we set $\hat{J}$=50% and $\hat{\pi}$=30%, as before. In addition, the return to capital is assumed to rise by 60% ($\hat{R}$=60) to align it with its world counterpart. In simulation 2, we consider the impact of the shortage for N alone. In simulation 3,[46] we consider the impact of the changes in the material input price and the return to capital only. We use the same set of structural parameter values as in the short run,[47] but also account for the ones relevant only in the long run. The long-run simulation results are summarized in Table 3. The results are stable; where there are opposite effects on a variable, the net impact is qualitatively independent of (plausible) parameter values.[48]

Regarding the commodity prices and factor returns, simulation 1 shows that the price of the non-tradable good falls slightly (by 2%). The change in P_N is negligible because the effects on the production cost of N of the changes in factor prices mostly offset each other. The overall price level falls even less (by 1%). However, the wage rate falls significantly

[46] Comparing these results with their counterparts in the short-run simulation 3 provides an approximate measure of the impact of the rise in the return to capital alone. Its impact on, for example, P_N, which is .009%, is revealed as 0% due to rounding of the figures.

[47] Using higher values for elasticities in the long run would change (increase) the results quantitatively but leave them intact qualitatively.

[48] See Appendix II.

(by 21%), and the return to land goes up by a very large amount (by 68%).[49] The real wage falls significantly (by 20%). Simulations 2 and 3 show that the shortage plays no role here, unlike in the short run.

Regarding the sectoral employment and output, simulation 1 shows that they rise significantly in sector N (by 42% and 39% respectively) and fall even by larger amounts in sector M (57% and 61% respectively), as in the short run. These changes can be attributed by and large to the shortage alone. The rise in the material price and capital rental has a relatively small negative effect in all cases (1%, 4%, 3%, and 7%, respectively), as shown by simulations 2 and 3. The employment and output in sector B rise by relatively small amounts (7% and 3% respectively), but the shortage plays no role in these changes.

The magnitude of the structural shift from sector M to sector N is mostly determined by the extent of the shortage inherited from the planning system, while the magnitude of the expansion in sector B depends solely on how misaligned the domestic material price and return to capital are from their world counterparts.

The impact of foreign aid on the above results is in the same order of magnitude as in the short run. In the likely amounts (e.g., 1% of the GNP), foreign aid has no noticeable impact. Only when it is over 2% of the GNP of the recipient economy, it takes some effect. When it is raised to 5% of GNP, compared with the "no aid" case, for example, the production of the non-tradable good and the manufactured good rises and falls respectively by 2% to 3% more, as in the short run. Foreign aid has no impact on factor and goods

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[49] It rises by 40% in the short run; the increase in the material cost raises it by 57% while the shortage lowers it by 17%.

prices in the long run, unlike in the short run.

5. CONCLUSIONS

This paper has studied the short-run and long-run structural impact of a comprehensive price and trade liberalization in the East European economies using a three-factor three-sector Small Open Economy model developed here. It has considered not only the rise in the material price, but also the rise in the capital cost, and the shortage for the non-tradables inherited from the planning era. In particular, it has analyzed the impact on the sectoral employment and output, the factor and commodity prices, and the real wage. Also, it has studied the impact of foreign aid on the results, and has illustrated the theoretical results quantitatively via simulation exercises.

Some of the short-run results are changed after removing restrictions on the mobility and substitutability of factors of productions, and incorporating a capital rental based on world prices. Unlike in the short run, world prices uniquely determine all domestic factor prices and, hence, the non-tradables price and the real wage in the long run. The inherited shortage has no impact on commodity prices and factor returns in the long run. However, where the shortage has an impact, it by far dominates the impact of the material price and capital cost adjustment, except for the short-run real wage (and the long-run capital stock). Both the shortage and the material price and capital cost adjustment have larger impact in the long run when complete adjustment occurs.

Using the manufacturing as numeraire, the non-tradables price and, hence, the overall price level rise significantly in the short run, but fall slightly in the long run. Also,

the wage rate rises in the short run but falls in the long run. The long-run results are opposite the short-run ones because the shortage has no impact on these variables in the long run. The return to land rises in both the short run and long run. The real wage, which may even rise in the short run, falls significantly in the long run. Its (small) decline in the short run is due to a (large) increase in the price of the non-tradables. Its (large) decline in the long run is due to a (large) decline in the wage rate.

The decline in the real wage and the rise in the real returns to capital and land may be expected because the labor services had been overpriced relative to that of capital and land under the planning system. However, this suggests that any biased distribution of capital and land among the public would allow certain social groups, as owners of capital and land, to obtain substantial windfall incomes. Also, it would encourage the migration of the (skilled) workers to high-wage countries, as observed in recent years.

The employment and production shifts significantly from the manufacturing to the non-tradables sector, with the long-run impact being about twice of the short-run one. In addition, the employment and production in the material sector, which is fixed in the short run, rises in the long run. The total capital stock and material usage fall in the long run.

The significant contraction of the manufacturing, along with a decline in the capital stock in the long run, point to a severe "De-industrialization" of the economy. The decline in the capital stock, or the negative investment, can lower not only average product wages but also the growth of the economy. However, the decline in material usage is concomitant with lowering the inherited high material intensity of production and with improving the material efficiency of the economy.

Foreign aid in credit reinforces the impact of the shortage, as part of the extra spending falls on the non-tradables. It further expands the non-tradables sector at the expense of the manufacturing. It, in likely amounts, has quantitatively negligible impact, however.

The extent of the impact of the liberalization is determined by the absolute and relative magnitudes of the initial conditions--the extent of the shortage for the non-tradables and of the tradables price distortions inherited from the planning era--of the newly-born market economy. As our simulations use minimum values for them, the quantitative results obtained here can be viewed as a lower bound, and larger impacts can be expected in the East European economies.

It should be noted that a lack of fully-developed (labor) markets (and stabilization policies) abound at the initial stage of the liberalization. Then, the structural adjustment manifests itself mostly, if not only, in the "downward" direction,[50] and stagflation ensues, as has been observed in socialist transitional economies. Even under the perfect market conditions assumed in this study a comprehensive price and trade liberalization would have mixed consequences. The traditional shortage industries would expand and consumers' demand for these goods, which had been long suppressed, would finally be satisfied. Yet, the economy would suffer from "De-industrialization" and falling real wages.

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[50] We address this in another paper titled "Wage and Price Control Policies in Socialist Transitional Economies" (mimeo).

APPENDIX I

A. The Structural Parameter Definitions

Θ_{ij}: the share of factor i in the unit cost of producing commodity j (i=L,K,B for sectors M and N; i=L,A for sector B; j=M,N in the short run; j=M,N,B in the long run).

λ_{ij}: the share of sector j in the total endowment of factor i (same definition for i and j as above).

σ_{Jv}: the elasticity of substitution between L and K in value added in sector j (j=M,N).

σ_j: the elasticity of substitution between value added and material input in sector j (j= M, N), and the elasticity of substitution between land and labor in sector j (j=B).

Φ_j: the share of commodity j in national income (j=M,N,B).

Φ_B: the ratio of total material usage over national income.

Φ_B^m: the ratio of the net import (export) of B over national income.

η_j: the income elasticity of demand for final good j (j=M,N).

e^j_N: the price elasticity of demand for final good j (j=M,N) with respect to the change in the price of N. (Where marked with a bar, it is the compensated elasticity.)

B. The Short-run Derivations

Consider the production side first.[51] The change in the wage rate ($\hat{W}$) can be expressed by:

$$\hat{w}=b_1\hat{p}_N-b_2\hat{\pi} \qquad (B.1)$$

where

$$b_1=\frac{1}{\Delta}\lambda_{LN}\frac{\sigma_{NV}}{\theta_{KN}}>0, \qquad b_2=\frac{1}{\Delta}(\lambda_{LM}\theta_{BM}\frac{\sigma_{MV}}{\theta_{KM}}+\lambda_{LN}\theta_{BN}\frac{\sigma_{NV}}{\theta_{KN}})>0,$$

[51] For the derivation steps taken, see Jones (1971).

$$\Delta = \lambda_{LM}\frac{\sigma_{MV}}{\theta_{KM}}(1-\theta_{BM}) + \lambda_{LN}\frac{\sigma_{NV}}{\theta_{KN}}(1-\theta_{BN}) > 0$$

The changes in labor demand in sectors M and N are given by:

$$\hat{L}_M = -(1-\theta_{BM})\frac{\sigma_{MV}}{\theta_{KM}}\hat{W} - \theta_{BM}\frac{\sigma_{MV}}{\theta_{KM}}\hat{\pi} \qquad (B.2)$$

$$\hat{L}_N = \frac{\sigma_{NV}}{\theta_{KN}}\hat{P}_N - (1-\theta_{BN})\frac{\sigma_{NV}}{\theta_{KN}}\hat{W} - \theta_{BN}\frac{\sigma_{NV}}{\theta_{KN}}\hat{\pi} \qquad (B.3)$$

where $\lambda_{LM}*\hat{L}_M + \lambda_{LN}*\hat{L}_N = 0$.

The output changes in sectors M and N are described by:

$$\hat{M} = -d_2\hat{W} - d_3\hat{\pi} \qquad (B.4)$$

$$\hat{N} = a_1\hat{P}_N - a_2\hat{W} - a_3\hat{\pi} \qquad (B.5)$$

where

$$d_2 = \theta_{LM}\frac{\sigma_{MV}}{\theta_{KM}} > 0, \qquad d_3 = \frac{1}{1-\theta_{BM}}(\theta_{LM}\theta_{BM}\frac{\sigma_{MV}}{\theta_{KM}} + \theta_{BM}\sigma_M) > 0,$$

$$a_1 = \frac{\theta_{LN}}{1-\theta_{BN}}(\frac{\sigma_{NV}}{\theta_{KN}} + \frac{\theta_{BN}}{\theta_{LN}}\sigma_N) > 0, \quad a_2 = \theta_{LN}\frac{\sigma_{NV}}{\theta_{KN}} > 0, \quad a_3 = \frac{\theta_{BN}}{1-\theta_{BN}}(\theta_{LN}\frac{\sigma_{NV}}{\theta_{KN}} + \sigma_N) > 0.$$

By substituting for $\hat{W}$ from above, the changes in labor demand and output in sectors M and N are expressed in terms of $\hat{P}_N$ and $\hat{\pi}$:

$$\hat{L}_M = -f_1\hat{P}_N - f_2\hat{\pi} \qquad (B.6)$$

$$\hat{L}_N = h_1\hat{P}_N - h_2\hat{\pi} \qquad (B.7)$$

$$\hat{M} = -m_1\hat{P}_N - m_2\hat{\pi} \qquad (B.8)$$

$$\hat{N} = n_1\hat{P}_N - n_2\hat{\pi} \qquad (B.9)$$

where

$$f_1 = \frac{1}{\Delta}(1-\theta_{BM})\frac{\sigma_{MV}}{\theta_{KM}}\lambda_{LN}\frac{\sigma_{NV}}{\theta_{KN}} > 0, \qquad f_2 = \frac{1}{\Delta}(\theta_{BM}-\theta_{BN})\frac{\sigma_{NV}}{\theta_{KN}}\lambda_{LN}\frac{\sigma_{MV}}{\theta_{KM}},$$

$$h_1 = \frac{1}{\Delta}(1-\theta_{BM})\frac{\sigma_{NV}}{\theta_{KN}}\lambda_{LM}\frac{\sigma_{MV}}{\theta_{KM}}, \qquad h_2 = \frac{1}{\Delta}(\theta_{BN}-\theta_{BM})\frac{\sigma_{NV}}{\theta_{KN}}\lambda_{LM}\frac{\sigma_{MV}}{\theta_{KM}},$$

$$m_1 = \frac{\theta_{LM}}{1-\theta_{BM}}f_1, \qquad m_2 = \frac{\theta_{LM}}{1-\theta_{BM}}(f_2 + \frac{\theta_{BM}}{\theta_{LM}}\sigma_M),$$

$$n_1 = \frac{\theta_{LN}}{1-\theta_{BN}}(h_1 + \frac{\theta_{BN}}{\theta_{LN}}\sigma_N), \qquad n_2 = \frac{\theta_{LN}}{1-\theta_{BN}}(h_2 + \frac{\theta_{BN}}{\theta_{LN}}\sigma_N).$$

Consider the demand side now. Totally differentiating the demand for N, substituting for $\hat{Y}$ and $\hat{W}$ yields:

$$\hat{N}^d = \gamma_1\hat{P}_N + \gamma_2\hat{\pi} \qquad (B.10)$$

where

$$\gamma_1 = \bar{e}_N^N - \eta_N m_1(\phi_M - \lambda_{BM}\phi_B) + \eta_N n_1(\phi_N - \lambda_{BN}\phi_B) - \eta_N\phi_B\lambda_{BN}\sigma_N,$$

$$\gamma_2 = \eta_N[\phi_B(\lambda_{BM}\sigma_M + \lambda_{BN}\sigma_N) - \phi_B^M - m_2(\phi_M - \phi_B\lambda_{BM}) - n_2(\phi_N - \lambda_{BN}\phi_B)].$$

The parameter γ_1 captures the total effect of a change in P_N on N^d. It consists of a direct effect via own price of N and an indirect effect via national income. As for the indirect effect, a change in P_N alters production of M and N, and, hence, national income. The

parameter γ_2 captures the effect of a change in π on N^d via national income. A rise in π decreases production of M and N and increases (or decreases) material imports bill, and, hence, alters national income. An increase in national income raises the demand for N, and vice versa.

Considering the production and demand sides simultaneously--deriving the impact on P_N from (S7) using (B.9) and (B10), and then substituting for it in (B.1) and (B.6)-(B.9)--the final parametric short-run results are obtained.

C. The Long-run Derivations

Totally differentiating (L.1)-(L.4) yields the impact on the commodity prices and factor returns, where

$$p_1=\frac{\theta_{KN}\theta_{LM}-\theta_{LN}\theta_{KM}}{\theta_{LM}}, \quad p_2=\frac{\theta_{BN}\theta_{LM}-\theta_{LN}\theta_{BM}}{\theta_{LM}}.$$

$$w_1=\frac{\theta_{KM}}{\theta_{LM}}, \quad w_2=\frac{\theta_{BM}}{\theta_{LM}}, \quad v_1=\frac{\theta_{LB}\theta_{KM}}{\theta_{AB}\theta_{LM}}, \quad v_2=\frac{\theta_{LM}+\theta_{LB}\theta_{BM}}{\theta_{AB}\theta_{LM}}.$$

Totally differentiating (L.5) and invoking the definition of elasticity of substitution between labor and land in B yields

$$\hat{B}_H=\sigma_B\theta_{LB}(\hat{W}-\hat{V}) \qquad (C.1)$$

Now, substituting for the respective factor price changes in this relation, the impact on B_H is derived.

On the factors side, totally differentiating (L.8), invoking the definition of elasticity of substitution between factors,[52] and substituting for the changes in factor prices and in B_H from above yields

$$\lambda_{LM}\hat{M}+\lambda_{LN}\hat{N}=(\psi_1 p_1-\psi_3 w_1+\psi_4)\hat{R}+(\psi_1 p_2-\psi_3 w_2+\psi_2)\hat{\pi} \qquad (C.2)$$

where

[52] Regarding sector B with two factors one of which is sector specific, see Jones (1965) or Corden and Neary (1982); and regarding sectors M and N with three factors and weak separability, see Bruno and Sachs (1982). This allows for substituting for the changes in a_{ij}s in terms of: elasticities of substitution, factor shares in unit costs, and factor price changes.

$$\psi_1=\frac{\lambda_{LN}\theta_{BN}\sigma_N}{1-\theta_{BN}}, \qquad \psi_2=-\lambda_{LB}\frac{\theta_{LB}\sigma_B}{\theta_{AB}}-\lambda_{LM}\frac{\theta_{BM}\sigma_M}{1-\theta_{BM}}-\lambda_{LN}\frac{\theta_{BN}\sigma_N}{1-\theta_{BN}}-\lambda_{LB}\sigma_B,$$

$$\psi_3=\lambda_{LB}\frac{\theta_{LB}\sigma_B}{\theta_{AB}}+\lambda_{LM}\frac{\theta_{KM}\sigma_{MV}}{1-\theta_{BM}}+\lambda_{LN}\frac{\theta_{KN}\sigma_{NV}}{1-\theta_{BN}}+\lambda_{LB}\sigma_B, \quad \psi_4=-\lambda_{LM}\frac{\theta_{KM}\sigma_{MV}}{1-\theta_{BM}}-\lambda_{LN}\frac{\theta_{KN}\sigma_{NV}}{1-\theta_{BN}}.$$

On the goods side, totally differentiating (S.7), substituting for the changes in Y,[53] in B_H, and in B,[54] and invoking the Slutsky decomposition of uncompensated price elasticities of demand as well as the definition of elasticity of substitution between factors yields

$$o_n\hat{N}+o_m\hat{M}=(o_1p_1-o_3w_1)\hat{R}+(o_1p_2-o_3w_2+o_2)\hat{\pi}+\hat{J} \qquad (C.3)$$

where

$$o_n=1-\eta_N(\phi_N-\lambda_{BN}\phi_B), \quad o_m=\eta_N(\phi_B\lambda_{BM}-\phi_M), \quad o_1=\bar{e}_N^N-\eta_N\phi_B\lambda_{BN}\sigma_N,$$

$$o_2=\eta_N(\phi_B\lambda_{BM}\sigma_M+\phi_B\lambda_{BN}\sigma_N-\phi_B^M+\phi_{BH}\theta_{LB}\frac{\sigma_B}{\theta_{AB}}), \quad o_3=-\eta_N\phi_{BH}\theta_{LB}\frac{\sigma_B}{\theta_{AB}}.$$

Considering (C.2) and (C.3) simultaneously, the output changes in sectors M and N are obtained, where

$$D=\lambda_{LM}o_n-\lambda_{LN}o_m, \qquad m_r=(o_n\psi_1-\lambda_{LN}o_1)p_1-(o_n\psi_3-\lambda_{LN}o_3)w_1+o_n\psi_4$$

$$m_\pi=(o_n\psi_1-\lambda_{LN}o_1)p_2+(o_n\psi_2-\lambda_{LN}o_2)-(o_n\psi_3-\lambda_{LN}o_3)w_2$$

$$n_r=(\lambda_{LM}o_1-o_m\psi_1)p_1-(\lambda_{LM}o_3-o_m\psi_3)w_1-o_m\psi_4$$

$$n_\pi=(\lambda_{LM}o_1-o_m\psi_1)p_2+(\lambda_{LM}o_2-o_M\psi_2)-(\lambda_{LM}o_3-o_m\psi_3)w_2$$

Totally differentiating $L_B=a_{LB}B_H$, $L_M=a_{LM}M$, and $L_N=a_{LN}N$, invoking the definition of elasticity of substitution between factors, substituting for the changes in sectoral outputs

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[53] This is obtained from totally differentiating (S.8).

[54] This is obtained from totally differentiating (L.7).

form above, the impact on the sectoral employment are derived, where

$$c_1 = -\frac{\theta_{KM}\sigma_{MV}}{1-\theta_{BM}}, \qquad c_2 = \frac{\theta_{BM}\sigma_{M}}{1-\theta_{BM}}, \qquad c_3 = -\frac{\theta_{KN}\sigma_{NV}}{1-\theta_{BN}}, \qquad c_4 = \frac{\theta_{BN}\sigma_{N}}{1-\theta_{BN}}.$$

APPENDIX II

A. Choice of Structural Parameter Values and Initial Conditions

The tradables/non-tradables sectoral dividing lines used in Goldstein and Officer (1979) are followed here.

The parameter values chosen are averages directly taken from the statistical data on East European countries or are derived from such data, all in consultation with certain studies.[55] The data of Bulgaria, Czechoslovakia, (former) East Germany, Hungry, Poland, and (former) Soviet Union (including Ukraine) are primarily used, due to their availability.

The sectoral shares in labor endowment/force (λ_{Lj}s) are based on the CIA's The World Factbook 1990. The sectoral shares in capital endowment/stock (λ_{Kj}s) and in material endowment/usage (λ_{Bj}s) are based on the United Nation's (1990) National Accounting.

The factor shares in unit costs (Θ_{ij}s) are obtained by drawing on: Marer et. al (1992); Kushnirsky (1993); Desai (1987); and the United Nation's (1990) National Accounting.[56]

The sectoral shares in GDP (Φ_js and $\Phi^M{}_B$) are based on: Marer et. al (1992); Corbo et. al (1991); and the CIA's (1989) Handbook of Economics Statistics.

The elasticities of substitution between production factors (σ_{jV}s and σ_js) are based on: Kushnirsky (1993); Desai (1987); Weitzman (1970); and Berndt and Wood (1975). The price and income elasticities of demand ($e^j{}_N$s and η_js) are based on: Walker (1989); and Spencer & Amos (1993).[57]

The initial conditions on material price and domestic interest rate are mainly based on Calvo and Coricelli (1992), Commander (1992), and Lipton and Sachs (1990a). There is no data/estimates on the actual size of the shortage for the non-tradables as a whole in the former centrally-planned economies. Its size (of 50%) is chosen here so that the resulting increase in the price of the non-tradables would be compatible with the derived rise in the material price and with the rise in the price of the non-tradables observed in these countries. As we double the values of these initial conditions, the change in almost all variables doubles.

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[55] Due to space limitations, the details of the calculations are not reported here.

[56] Kushnirsky (1993) and Desai (1987) estimate labor and capital shares in unit cost from two-factor CES production functions for Ukraine economy and Soviet economy respectively.

[57] As these studies are on market economies, the planned economies are assumed fundamentally similar to the market economies with respect to the demand side or the consumers' preferences.

B. Sensitivity Tests of the Results

We conducted twenty six sensitivity tests on the five sets of structural parameters listed in Table 1.[58] Because of unity restrictions, some interrelated parameters were varied and tested in groups while others remained unchanged. Only the short-run real wage showed some sensitivity to the parameter values used in the simulations.

In the nine tests on the sectoral shares in factor endowments (λs), only in the case where the labor shares of sectors M and N were about one fourth and one half respectively, the real wage rose, instead of declining, by a small amount (by 3%).

In the six tests on factor shares in unit costs (Θs), in the case where the capital share in unit cost of M was almost doubled, at the expense of the labor share, to about one quarter, the real wage rose (by 8%). Naturally, in the implausible case where it was raised further to two third, the real wage rose significantly (by 26%).

In the four tests on sectoral shares in GDP (Φs), in the case where the shares of M and N in GDP were switched, the real wage rose by a small amount (by 4%).

In the four tests on elasticities of substitutions between factors (σs), the one between labor and capital in both sectors M and N expectedly affected the real wage. When that in sector N was doubled, the real wage rose (by 5%).

In the three tests on price and income elasticities of demand (es and ηs), in the implausible case where the income elasticities of M and N were equal/unity, the real wage did not change.

Thus, in certain cases the real wage rose and did not decline in the short run. But, all other simulation results were stable and remained qualitatively intact. In the long run, in the two cases of L_N and N, where the price alignment and the shortage have opposite effects, the effect of the shortage easily dominates. The real wage falls regardless of parameter values, unlike in the short run.

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[58] Due to space limitations, the tables containing these tests and the respective explanations are not reported here.

Table 1: The Parameter Values Used in Simulations[59]

Production side:

Sectoral shares in factor endowments:
λ_{LM} =.36
λ_{LN} =.45
λ_{KM} =.39
λ_{KN} =.61
λ_{BM} =.60
λ_{BN} =.40
λ_{LB} =.19

Production technology:
M = M (V (L,K), B)
N = N (V (L,K), B)
B = B (L, A)
σ_{MV} =.2 (L and K in V of M)
σ_{M} =.1 (V and B in M)
σ_{NV} =.2 (L and K in V of N)
σ_{N} =.1 (V and B in N)
σ_{B} =.1 (L and A in B)

Factor shares in unit costs:

θ_{LM} =.66	θ_{LN} =.71	θ_{LB} =.42
θ_{KM} =.13	θ_{KN} =.14	θ_{AB} =.58
θ_{BM} =.21	θ_{BN} =.15	

Demand side:

Sectoral shares in GDP:
Φ_{M} =.56 Φ^{M}_{B} =.05
Φ_{N} =.49
Φ_{B} =.19

Price and income elasticities:
e^{N}_{N} =-0.7 e^{M}_{N}=.13
η_{N} = 1.2 η_{M} =.9

[59] These parameter values are mostly derived from the statistical data of Bulgaria, Czechoslovakia, (former) East Germany, Hungary, Poland, and (former) Soviet Union (including Ukraine); see Appendix II.

Table 2: The Short-run Simulation Results[60]

	1 $\hat{\pi} = 30\%$ $\hat{J} = 50\%$	2 $\hat{\pi} = 0$ $\hat{J} = 50\%$	3 $\hat{\pi} = 30\%$ $\hat{J} = 0$
change in P_N	35%	37%	- 2%
change in P	17%	18%	- 1%
change in W	16%	24%	- 8%
change in W/P	- 1%	6%	- 7%
change in L_M	-29%	-29%	-0.3%
change in L_N	23%	23%	+0.2%
change in M	-25%	-24%	- 1%
change in N	20%	20%	-0.4%

Table 3: The Long-run Simulation Results[61]

	1 $\hat{\pi} = 30\%$ $\hat{R} = 60\%$ $\hat{J} = 50\%$	2 $\hat{\pi} = 0$ $\hat{R} = 0$ $\hat{J} = 50\%$	3 $\hat{\pi} = 30\%$ $\hat{R} = 60\%$ $\hat{J} = 0$
change in P_N	-2%	0%	-2%
change in P	-1%	0%	-1%
change in W	-21%	0%	-21%
change in V	68%	0%	68%
change in W/P	-20%	0%	-20%
change in L_M	-57%	-54%	-3%
change in L_N	42%	43%	-1%
change in L_B	7%	0%	7%
change in M	-61%	-54%	-7%
change in N	39%	43%	-4%
change in B_H	3%	0%	3%

[60] The discrepancy across certain rows is due to rounding the figures.

[61] The impact on K is -13%, 5%, and -18%, while that on B is -24%, -15%, and -9%, respectively. Again, the discrepancy across certain rows is due to rounding the figures.

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