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THE IMPACT OF UNBALANCED PRODUCTIVITY ADVANCE ON INDIAN URBANIZATION: SOME PRELIMINARY FINDINGS

by

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ABSTRACT

This paper investigates the impact of changes in sectoral productivity on output and employment patterns in a simulation model of the Indian economy. Productivity gains in major urban sectors are found to have fairly strong urban growth effects both in the short and long run. Rural productivity advances initially stem urban growth, but have little long run effect.

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URBANIZATION: SOME PRELIMINARY FINDINGS

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INTRODUCTION

India's development trends differ in many critical respects from stylized growth patterns. Its urban population has grown at the moderate annual rate of 3.8%, just less than twice the national population growth rate. Yet this persistent urbanization has not been accompanied by large structural shifts in employment and output composition. Furthermore, incremental capital/output ratios have experienced alarming growth, especially in predominantly urban sectors.

The unusual circumstances of India's growth indicate that a thorough analysis of Indian economic growth and its relation to urbanization would be valuable. In order to provide such a study, we have constructed a multi-sector model of Indian rural-urban migration, city growth and economic development (Becker, Mills and Williamson [2], ; hereafter "BMW"). Since many of the critical forces of relevance to the city growth issue cannot be captured adequately by a single analytical model, we have designed a more complex model that is solved by numerical techniques. The model will serve eventually to forecast future urban growth under varying assumptions regarding exogenous variables' values. Counterfactual simulations can also be used to assess the contributions to recent urban growth of productivity changes, world market conditions, capital accumulation, skilled labor formation, demand shifts and changes in fiscal policy. This latter exercise requires us to derive a comprehensive understanding of the impacts of these forces, both in the short run and over time.

This paper begins the analysis of the sources of Indian urbanization and output growth by examining the impacts of sector-specific, disembodied technological change. Since sectoral factor productivity growth rates do appear to vary in India, it is important to determine the effects on urbanization of such differences. After presenting a brief description of the model, we report results from counterfactual simulations of the Indian economy for the 11 year period 1960-1970 that predict how the Indian economy would have responded at that time to changes in productivity parameters from their estimated values.

THE BMW MODEL OF INDIAN URBANIZATION

BMW offers a dynamic general equilibrium simulation model of the Indian economy. It is oriented in particular to analyzing variables likely to influence urbanization that have been omitted in previous models. The framework is predominantly neoclassical, but migrants' moving costs are recognized, as are segmented capital markets.

A major difference between BMW and other computable general equilibrium ("CGE") models of LDCs involves the role of government in a poor, mixed enterprise economy. In BMW, government has the option of consuming goods and services, providing transfers to households, delivering public services to households and industries, or investing in government enterprises. Most CGE models minimize government's role by assuming similar public and private investment behavior, and by ignoring differences in public and private enterprises. BMW explicitly confronts the effects of non-competitive government investment allocation, and incorporates government relationships with public enterprises in its fiscal system. BMW also recognizes the critical role of public services as intermediate inputs, and thus provides a direct role for government in the production process. These public services comprise the major components of infrastructure: roads, some transport, power, water, and health services. We treat these as private intermediate products used in the production of final goods, and assume that their provision is biased towards urban industries and wealthy households.

BMW's characterization of India should be consistent with major private sector institutions as well. These characteristics include highly fragmented capital markets and a partially segmented labor market. Earnings differ by skill classes in BMW, and since laborers of different skills are not close substitutes, skilled and unskilled labor markets are quite distinct. Yet unskilled and skilled labor both are present in the traditional and rural as well as the modern and urban sectors. Models often omit consideration of skilled labor outside the modern urban sectors, but a model designed to analyze Indian rural-urban migration cannot justifiably ignore the presence of a substantial body of educated, skilled labor in rural India. Indeed, our results find that the proportion of skilled workers in migrant streams tends to be higher than their share of the national labor force. Finally, neither profit nor rental income accrues exclusively to one class, as many models assume.

The model distinguishes between tradeable and non-tradeable goods, and consumption of some services and housing is therefore location-specific. This specificity, along with different consumption patterns and the presence of location-specific taxes, generates differences in urban and rural households' living costs. Two goods are internationally tradeable:manufactures and agricultural products. India is a producer,consumer, importer and exporter of both goods. Following Armington [1], we assume export demand functions with finite price elasticities, and also assume that imported goods are imperfect substitutes for domestically produced goods of the same type.

In view of our desire to understand Indian growth while minimizing complexity, BMW includes ten sectors and four productive factors. The model includes agricultural and urban manufacturing, which together absorb most of the labor force. As with the Kelley-Williamson [4,5] CGE model of a "representative developing country", BMW contains rural and urban "informal" service sectors as well as a skill- and capital-intensive service sector that produces largely public administration.[1] Again following Kelley-Williamson, there are three housing sectors--rural housing, urban "informal" housing of low quality, and urban "formal" housing of higher quality. Finally, the model distinguishes separately urban public services (power, other utilities, some transport) and rural public services (largely public irrigation and rural public administration). Although these public service sectors are not large employers in India, they do utilize large portions of the nation's capital stock and provide essential intermediate goods to other sectors. The four factors in BMW are capital, skilled labor, unskilled labor, and land.

Numerical solutions to the BMW program require the derivation of a set of consistent parameter values. Insofar as is possible, these values are based on available econometric results. For values not thereby restricted, we compel the model to exactly replicate observed national accounts and other data for a "benchmark equilibrium" year, chosen to be 1960. That is, we choose unknown parameter and exogenous variable values to force the model's solution to provide estimates of endogenous variable values identical to those actually observed for 1960. Once base year exogenous variables are known, they can be systematically revised for succeeding time periods. For example, 1961 capital stocks equal 1960 capital stocks plus endogenously determined 1960 net investment levels.

A small set of technological change parameters are not restricted by the static data consistency requirement. These parameters are derived by assuming that India experienced an "equilibrium growth era" during the 1960s. Given static parameter values and initial exogenous variable values along with historical series for exogenous variables such as world prices, BMW is solved for its endogenous variable values in the absence of any technological progress. We then compare actual and simulated values of key endogenous variables and calculate residual productivity gains not explained by capital accumulation and labor force skill acquisition. Once we have derived dynamic parameter values by an iterative process from our equilibrium growth era restrictions, the model can be run forward, with its performance judged by its ability to replicate output and employment patterns from the 1970s and early 1980s.

The dynamic parameters are now in the process of being derived. Those values used in the simulations reported here were derived under the simplifying assumption that all productivity changes occurred as Hicks-neutral factor-disembodied multiplicative shifts in the sectoral production functions. These parameters are preliminary, as the Hicks-neutrality restriction enables the model to successfully track sectoral output paths, but generates greater urban

[1]However, BMW's RS sector includes a large rural manufacturing component in addition to rural private services.

employment creation than that actually recorded. This finding indicates that a labor-saving bias has been present in urban manufacturing (and possibly in other urban sectors' technological change). Given the rapid growth of registered manufacturing relative to unregistered manufacturing, the presence of such a bias at an aggregate level is hardly surprising.

The dynamic parameter values employed here provide good measures of overall sectoral productivity advance (though urban technological progress may be slightly understated and rural gains overstated: see [3]). However, presence of labor-saving bias in some urban sectors, along with needed demographic data refinements, force these figures to be preliminary. The productivity parameters chosen also differ for the periods 1960-1964 and 1965-1970, reflecting the latter periods' dramatic decline in the urban manufacturing and in public service sector's growth. Simulations beyond 1970 will assume that long term productivity growth is an average of the extremely successful early 1960s and unsuccessful late 1960s.[2]

STATIC AND DYNAMIC EFFECTS OF A ONE TIME PRODUCTIVITY SHOCK

Table 1 reports elasticity values for key urbanization and macroeconomic variables with respect to productivity parameter changes. Each counterfactual simulation involves a sector-specific, Hicks-neutral technological improvement. Specifically, the simulations increase the ith sector production function's multiplicative constant term A_i for the entire period 1960-1970. The impact of this technology shock involves immediate reactions in labor, product, and foreign trade markets. Investment behavior responds as well, but stock adjustments occur with a one year gestation lag. Cost of living differential changes are also assumed to have a lagged effect on migration decisions.

The figures presented in Table 1 reflect full general equilibrium influences, and will differ from the partial equilibrium multipliers commonly used, but the impact of the disembodied technological progress on output and relative price of the affected sector's good depends critically on this general price elasticity of demand. If output demand is relatively price elastic, then productivity growth will be reflected in large output supply responses in the affected sector. If output demand elasticities are low, then cost-reducing innovations will be passed on to users via falling prices. Resources will flow to the affected sector if the full general equilibrium rise in output is proportionately greater than the productivity gain itself. If demand elasticities for urban goods are high and urban sectors experience relatively large total factor productivity ("tfp") growth, then final demand will shift toward urban goods. GNP will become dominated increasingly by urban sectors, new urban employment opportunities will appear, and city growth will take place. It will also take place if productivity advances in rural sectors occur, but are met instead by low price and income demand elasticities.

In Table 1, disembodied improvements in all "modern" urban industries are met with sufficiently buoyant short run demand elasticities that the own sector equilibrium supply response elasticity exceeds unity. Since the output growth rate for urban manufacturing (M), public service (PSU) and modern services (KS) exceeds tfp growth, input use must grow. With capital fixed initially, labor use therefore increases. As in the Kelley-Williamson (KW) small, open economy, 1% A_M growth generates a strong supply response: 74,000 workers migrate to cities, of whom 29,000 find M sector employment. But the price of M sector value added also declines 0.89% in the partially closed Indian economy, resulting in a smaller urbanization impact than if the economy were fully open.[3]

Short run output, own sector employment and total urbanization effects are even greater in the case of KS tfp growth, although KS gross output is 45% smaller than M's. Moreover, the literature known as economic base theory tends to describe service sector output growth as responding to growth in manufacturing (see Mills and Becker [6], Ch. 6). A major reason for the greater KS urbanization elasticity is that M is capital intensive relative to KS, so that its short run supply curve will be steeper. KS also faces a highly elastic demand curve: government tax revenue rises by 0.16%, most of which is automatically spent on purchasing KS goods. In addition, an HKS housing investment spiral takes place. As KS value added price falls proportionately less than the technology gain, factor marginal value product schedules increase; labor then migrates to urban areas. In particular, a high skilled labor growth elasticity (0.49) is recorded in response to skilled labor intensive KS's tfp gain, driving up the demand for high quality urban housing (HKS), encouraging investment in

[2] Total non-housing productivity advance declined from 1.15% in 1960 to -0.3% in 1968. The productivity parameters calculated for the 1960s can also be compared with other residuals estimated in growth accounting exercises. It is interesting to note that BMW does not find a strong "green revolution" spurt in agricultural productivity during the late 1960s once output levels have been corrected for variations in rainfall, labor quality and intermediate input use.

[3] Relative price elasticities reported are deflated by a domestic production based Laspeyres price index.

TABLE 1. STATIC AND DYNAMIC IMPACTS OF UNBALANCED PRODUCTIVITY ADVANCE: COUNTERFACTUAL SIMULATIONS FOR INDIA, 1960-1970

(The counterfactual simulation concerning productivity advance in sector i involves a 1% increase in the disembodied multiplicative technological progress term A_i in the ith sector's production function.)
Elasticities and Population Changes are reported with respect to benchmark (no technology shock) values.

Endogenous Variable / Counterfactual Simulation: 1% increase in	A_A	A_{RS}	A_{PSR}	A_M	A_{KS}	A_{US}	A_{PSU}
1. Increase in Urban Labor Force (thousand workers)							
1960	-116	-232	-143	74	266	-62	112
1961	155	81	157	127	537	244	34
1962	- 49	- 21	- 78	156	171	-123	-208
1963	282	341	188	393	403	295	251
1964	-122	- 28	- 43	199	182	-83	-143
1965	-108	- 48	-312	128	278	-45	235
1966	- 41	- 47	64	149	54	57	76
1967	- 7	- 44	-188	126	321	-128	40
1968	- 7	- 70	110	225	337	141	50
1969	35	- 56	- 54	202	329	-37	48
1970	-158	-141	1	328	345	105	45
2. Own Sector Constant (1960 pre-shock) Price Output Elasticity with Respect to Productivity Advance							
1960	0.91	1.84	1.44	1.17	1.88	0.65	1.80
1961	0.77	1.53	0.35	1.23	1.44	2.08	1.33
1962	0.89	0.52	1.57	2.07	0.56	-0.06	0.03
1963	0.94	0.37	1.11	1.89	1.12	1.85	1.02
1964	1.09	0.61	1.59	1.61	1.18	0.47	1.11
1965	0.96	0.58	1.79	1.25	1.12	1.09	1.09
1966	0.97	0.63	1.07	1.30	1.64	0.77	1.05
1967	0.93	0.67	1.11	1.20	0.95	0.36	1.08
1968	0.94	0.75	1.07	1.48	1.02	1.21	1.10
1969	0.94	0.74	1.15	1.48	1.02	0.64	1.10
1970	1.05	0.73	1.02	1.66	1.21	0.28	1.09
3. Own Sector Unskilled Labor Employment Elasticity							
1960	-0.13	1.01	0.75	0.37	1.48	-0.47	1.30
1961	-0.28	0.30	-0.74	0.35	1.00	1.50	0.44
1962	-0.03	-0.68	0.89	1.49	0.11	-1.36	-1.49
1963	-0.06	-0.55	0.14	1.21	0.69	1.36	0.05
1964	0.10	-0.34	0.72	0.76	0.66	-0.52	0.19
1965	-0.09	-0.46	0.84	0.35	0.66	0.26	0.16
1966	-0.09	-0.38	0.14	0.42	1.33	-0.10	0.08
1967	-0.11	-0.33	0.14	0.30	0.52	-0.63	0.12
1968	-0.10	-0.25	0.27	0.64	0.55	0.49	0.13
1969	-0.09	-0.25	0.27	0.61	0.52	-0.31	0.13
1970	0.04	-0.26	0.00	0.87	0.71	0.24	0.13
4. Own Sector Skilled Labor Employment Elasticity							
1960	-0.32	1.00	0.46	0.27	0.97	-0.43	1.00
1961	-0.56	0.48	-0.76	0.18	0.53	0.80	0.48
1962	-0.42	-0.46	0.66	1.08	-0.32	-1.16	-0.13
1963	-0.18	-0.50	0.14	0.84	0.30	0.74	0.00
1964	0.06	-0.36	0.69	0.57	0.29	-0.35	0.38
1965	-0.27	-0.29	0.92	0.20	0.21	0.00	0.00
1966	-0.30	-0.25	0.06	0.19	0.77	-0.31	0.00
1967	-0.30	-0.22	0.12	0.12	0.05	-0.60	0.00
1968	-0.29	-0.18	0.06	0.38	0.14	0.00	0.00
1969	-0.36	-0.17	0.22	0.04	0.14	-0.53	0.27
1970	-0.09	-0.16	0.05	0.67	0.30	0.00	0.00

Glossary of Sectors:

- A - Agriculture and Raw Materials
- RS - Rural Services and Manufacturing
- PSR - Rural Public Services and Government Administration
- M - Urban Manufacturing
- KS - Urban Capital or Skill Intensive Services and Government Administration
- US - Urban Informal Sector Services
- PSU - Urban Public Services
- HRS - Rural Housing Services
- HUS - Urban High Quality Housing Services
- HKS - Urban Low Quality Housing Services

that sector. As HKS structures are produced in the KS sector, cost declines further induce investment, so that these secondary effects are strongly reinforcing.

The presence of a stock of rural skilled labor is critical in determining urbanization impacts of KS tfp gains. In the absence of a rural skilled labor force, short run KS supply responses would be muted by skilled-labor bottlenecks. Short run demand for KS similarly would be restrained by the absence of an HKS housing boom. Modern services consequently have far more important urban growth effects in EMW than in earlier general equilibrium models that ignore the possibility of an influx of educated workers from rural areas.

Longer run effects differ considerably from short run impacts. Strong cyclical behavior emerges as the KS housing boom dissipates rapidly. Over the ten years following the initial reaction (1961-1970), the average KS output increase over its base value in the A_{KS} growth simulation is only 1.01%, while the M sector response in the A_M growth simulation averages a 1.52% increase. These differences reflect a continued bouyant demand for physical investment goods (produced in the M sector), in contrast with a dissipation of initial housing booms generated by the initial flow of urban immigrants. The initial capital constraint, which affects M more than KS, also is reduced over time, while the presence of rural skilled workers prevent a skill constraint from strongly limiting initial KS growth. This skill constraint becomes a more important curb to KS growth than does the capital constraint to M growth in later years though, as capital accumulates relatively rapidly, especially given the tfp gain in the capital goods (M) sector.[4]

Although the KS expansion recedes in the A_{KS} advance case, its total urbanization effect continues to be the largest, though urbanization effects of A_M and A_{KS} growth are much closer in the long run than they are initially. Since own sector employment elasticities after 1960 are typically higher in the A_M growth than in the A_{KS} growth case, and since M employs more workers, it is apparent that KS tfp growth generates much employment growth in other urban sectors. This success in part reflects a change in consumption patterns in favor of urban goods due to a rise of real incomes of the very top groups in the A_{KS} shift relative to the A_M shift and to the benchmark. Somewhat surprisingly, though, real incomes of skilled workers exhibit little long run changes in response to the A_{KS} gain.

A second reason for the large long run urbanizing influence of KS tfp gains relative to the A_M gain involves the substitution of capital for labor. While the M tfp gain is Hicks-neutral, it has the economy-wide bias of making capital goods inexpensive relative to skilled and unskilled labor. The shift in relative prices enables the urban savings pool to support a surge in the urban capital stock that to some extent in aggregate substitutes for labor inputs, thus limiting urban immigration. Since urban sectors are capital intensive relative to rural sectors, and since the urban formal sector savings pool is the largest relative to value added, the fact that savings pools will purchase more capital goods in the A_M gain case does have the effect of greatly expanding production in urban sectors relative to rural sectors.

The impact of this labor displacement can be seen by comparing combined output and capital use in the four non-housing urban sectors at a point well after the establishment of the productivity shift.

Table 2
1968 Urban Output and Capital Stocks in the M and KS Productivity Gain Simulations
(Values are for all urban non-housing sectors combined in 1960 benchmark Rs.billion)

	Capital (K)	Output (Q)	K/Q
Benchmark	183.416	77.194	2.376
M tfp increase	184.571	77.864	2.370
KS tfp increase	183.717	77.708	2.364

Thus, while there are 112,000 more urban workers in 1968 in the A_{KS} gain case compared to the A_M gain case, total 1968 urban output is greater in the latter simulation due to the greater accumulation of capital goods.

The urban public service (PSU) 1% productivity advance has surprisingly large urbanization and own sector output initial impact multipliers. This response stems partly from the

[4] Thus, in the M tfp advance case, capital's (K) share initially rises relative to benchmark values (as factor substitution elasticities are below unity in the modern urban sectors, and skilled labor's (S) falls. By the mid-1960's, however, this situation has reversed itself (though S and K shares both rise in on KS sector).

elastic demand curves it is assumed to face as a supplier of intermediate goods. There is also a strong government tax revenue effect (a 0.32% rise), and the resulting government expenditures have a strong urban bias. The tfp gain in this capital and skill intensive sector also redistributes incomes toward skilled labor and capitalist classes, away from unskilled urban labor. The ratio of urban skilled to unskilled workers' earnings rises more than 1.5%. As wealthy classes have relatively urban-intensive consumption patterns, the effect of increasing inequality is to further increase urban growth in all sectors.

These strong PSU tfp gain impact effects are not sustained. After initial cyclical affects abate, PSU own output elasticities range around 1.1, implying little additional factor usage beyond the benchmark values. The initial urban influx of 112,000 workers fluctuates considerably and then falls to an average gain of 40-50,000 over the benchmark, nearly an order of magnitude lower than in the KS or M tfp gain cases. The reduced long run employment effect reflects adjustments to changes in cost-of-living differentials as well as negligible long run capital accumulation relative to the benchmark (the 1968 urban non-housing capital stock elasticity is 0.04 in the PSU tfp gain simulation, as compared with 0.16 and 0.63 in the KS and M productivity gains, respectively). This low capital accumulation elasticity occurs despite large public revenue gains, as government investment patterns influence movements away from investment in the capital goods sector towards accumulation in KS and PSU. The absence of additional capital to further raise labor productivity beyond the initial urban productivity gain thereby restrains additional immigration.

Alone among the urban sectors, productivity advance in informal sector services (US) does not increase its own workforce or the total urban workforce in the short run. Its most striking effects are the creation of rural services investment and output booms due to the urban emigration and to create urban housing booms due to input cost declines. Reverse migration effects are severe enough to generate a slight decline in the demand schedule for US goods, and hence to a price fall proportionately greater (1.04%) than the output increase (0.64%). This perverse instability does not last, though. As housing and capital investments are completed, they raise labor productivity and lower costs of urban goods, while declines in relative urban living costs due to the US tfp gain further encourage urban immigration. Finally, a slight decline in the 1961 rainfall index itself provokes rural-urban migration: in the US productivity gain case these rainfall effects are magnified because the 1960 rural population had grown in comparison with the benchmark.

Abstracting from the cycles provoked, the long run effect of a 1% US tfp gain is a 40-50,000 increase in the urban labor force. Most of this gain is in sectors other than US, which tends to experience employment decline: its average output elasticity over the period 1961-1970 is only .89, despite a slight increase in long run capital stock. US capital formation is severely limited by the isolation of the informal sector capital market, though, so that capital accumulation is constrained by the size of the market's savings pool; US employment is indirectly constrained. In summary, then, it appears that all urban sector productivity shifts have positive long run urbanization impacts, but that these effects are small for the US and PSU shifts.

Rural productivity gains have weak long run migration effects but large impact multipliers. Productivity gain in India's largest sector, agriculture (initially employing 71% of the labor force and producing 48% of non-housing GDP) leads to an initial decline in the agricultural labor force, since constant price value added rises proportionately less than the productivity gain. Agricultural products are used primarily in final consumption, or as intermediates into the M sector agricultural processing industry. Low demand elasticities, especially from India's rural poor, thus prevent demand for A from rising rapidly. The A_A productivity shift nonetheless does have the impact effect of increasing rural incomes considerably (real per capita consumption of the rural poor rises 0.41%), and much of this income growth is spent on other rural consumer goods (RS and HRS). Real income growth is sufficiently great and demand leakages for urban goods sufficiently limited, then, that the aggregate effect of an agricultural productivity shift is to raise demand for factors of production in rural areas. This demand increase induces a moderate urban emigration despite the 173,000 worker decline in agricultural employment.

The urban emigration generated at the A tfp shift does not persist into the long run. The initial decline in urban living costs relative to rural living costs operates with a lag to reverse the urban emigration. These effects are reinforced by the end of the initial rural construction boom, though both sets of effects continue to generate cyclical behavior into the mid-1960s. Excluding 1964 and 1970, urban emigration in response to the A_A shift is very small (especially given the size of the agricultural sector) after the cyclical effects have moderated, averaging only 26,000 in the period 1965-1969. 1964 and 1970 were exceptionally good crop years, so that the productivity shift and natural circumstances interact to magnify migration trends.

Rural services and manufacturing (RS) productivity advance has short run impacts symmetric to the KS sector in the A_{KS} growth case. Demand elasticities are sufficiently high that RS's marginal value product rises in the absence of factor movements, as RS produces both major rural investment and consumption goods RS consumption goods also benefit from assumed Engels effects, as these goods are the major rural alternative to food consumption. As capital is immobile "putty-clay", labor use increases by 262,000 workers in RS and 20,000 workers in other rural sectors. A housing boom follows the rural immigration, further raising demand for RS-produced rural construction.

The RS sector's high labor share (74%) also ensures that it will enjoy an elastic short run supply curve, so that demand growth stemming from increased incomes and new rural workers (especially skilled) will be met by rising output instead of higher prices. This high elasticity also distinguishes RS from A, which has large initially immobile capital (16%) and land (30%) shares.

As the investment boom in rural housing passes, and as the urban/rural living cost differential declines, the initial urban emigration effect is counteracted strongly. The average urban emigration level in response to the A_{RS} tfp shift is only 33,000, a far weaker response than the long run KS urbanizing influence. The asymmetry stems in part from the government expenditure effect: productivity gains raise tax revenue, which in turn are spent on urban products. It also stems from rural demand leakages: as rising incomes and population increase the rural savings pool relative to the benchmark, demand for urban investment and consumption goods grows. In the A_{KS} growth case, investment growth effects reinforce initial urbanizing tendencies. However, rate of return insensitivity of rural and urban (both formal and informal) savings pools moderate such investment effects.

The message from these simulations is disheartening to Indian policymakers interested in stemming urban growth by increasing rural productivity. While short run impacts of rural tfp gains are considerable, their ability to stem urban growth in the long run is quite small. Barring dramatic shifts in government expenditure patterns or the development of a rural capital goods industry, demand patterns with large long run leakages limit the extent to which rural technological improvements forestall urbanization.[5]

Productivity advance in rural public services also fails to generate large long run rural labor force increases. Initial increases in the rural labor force are registered, but this gain largely reflects a rural construction boom and rapid RS output growth as new migrants consume rural services in place of urban services. Price movements that generate rising relative costs of rural living and an end to the rural housing construction boom again make these large multipliers short-lived. While PSR's output multiplier consistency exceeds unity and its employment multipliers are positive, the total rural employment creation effect of A_{PSR} advance is small, averaging only 13,000 workers in the period 1961-1970.

CONCLUDING REMARKS

The asymmetric effect of tfp advance in urban and rural sectors on urbanization found in other CGE models also appear in BMW. However, urban manufacturing is joined by modern services in having large urbanization effects in response to productivity advance in that sector. The partially closed nature of BMW prevents dramatic migration effects from tfp gains in the tradeable goods' sectors. Instead, household demand patterns, government expenditure patterns and the urban location of investment goods production combine to make locational leakages much more severe for rural sector productivity gains than for urban tfp increases.

One might also inquire as to whether sustained increases in the tfp growth rate generate different results. Suppose, for example, that a more universal green revolution than was actually experienced led to a rise in the annual increase in agricultural disembodied technological progress from 0.6% to 1.6%--an increase certainly close to the plausible maximum gain. If this gain is sustained throughout the period 1960-1970, the counterfactual simulation yields large A sector output gains relative to the benchmark (11% by 1970). Yet even this sustained growth increase generates only a modest average (1964-1969) decrease in the urban labor force of 49,000 workers relative to benchmark values. This shift is minor compared with the average urbanization impact of a one-time improvement to productivity in the M or KS sectors. In summary, unless agricultural technology gains contain strong factor-saving biases not considered here, even sustained agricultural productivity growth increases will have relatively minor (less than 0.2% of the urban labor force) urban emigration effects.

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[5] BMW assumes that all rural non-construction investment goods are produced in the M sector. To the extent that this is an unrealistic assumption, then, the urbanization asymmetries between rural and urban tfp gains will be overstated.

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