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THE ECONOMICS OF
SOVIET SOCIAL INSTITUTIONS

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THE ECONOMICS OF SOVIET SOCIAL INSTITUTIONS

SUMMARY*

In the West, there has of late been a flourishing development of the economic analysis of non-economic institutions such as education, the family, health systems, politics, law and crime, and so forth. The objective of this research project was to extend our understanding of the institutions of Soviet society by the application of methods of economic analysis that have proven fruitful in the study of western social institutions. The institutions selected for study were the family, the education system, and the health system.

From a broad perspective, the common features of these three social institutions are striking. As in a market economy, Soviet citizens make decisions on the basis of the perceived private costs and benefits of the alternatives. The State can heavily influence the terms on which individuals make choices. It tries to give the "right" signals so that the choices made by Soviet citizens are best not only for the individual, but for the society as a whole as interpreted by the State. Nonetheless, overall social outcomes are the end results of millions of Soviet citizens making choices regarding which technical school to apply to, how many children to have, and whether to enter the hospital or take one's chances at home. In the social sphere the Soviet Government cannot command that certain choices be made nearly to the extent that it can in the economy.

Demographic, manpower, economic, social and health care problems of the 1980s will require that the Soviet leadership provide direction and incentives to the Soviet populace to lower birth rate in some areas and raise it in others, to plan to enter certain spheres of employment or be directed to enter another, and so on. The choice is between an attempt at greater interference by the State in socio-economic decision-making, or providing incentives, at the possible expense of investment and economic growth, which encourage the Soviet population to follow a path determined by the State to get through the 1980s.

* Prepared by the National Council.
The Family

Analysis of the "family" focused on identifying the economic, social, and cultural factors that exert the greatest influence on fertility in Soviet families. The principal findings are as follows. First, the variation in the fertility rates of Soviet females is determined primarily by socio-economic conditions such as level of urbanization, education, Republic per capita income, and labor force participation, which together account for 73% of the variation. The cultural influence, as measured by observing Moslem fertility patterns, accounts for only 13% of the variation. Culture plays a larger role than that, however, because certain socio-economic factors -- for example, the difference in the educational levels of Moslem and non-Moslem women -- are also in part the consequence of cultural traditions.

Females with a higher or specialized secondary education have fewer children than those with less education, as in most developed countries. When differences in labor participation rates are taken into account, however, those with higher education have more children than those without. This is true for both Moslem and non-Moslem females, as well as for urban and rural populations. The exception is rural Moslem women with little education whose fertility rises when they acquire secondary education. This is an instance of "premature modernization" sometimes found in developing countries where women acquire the ability to control their fertility before their socio-economic status has motivated them to wish to reduce it. Thus, if the Soviet leadership attempts to increase the fertility rate by encouraging mothers to withdraw from the labor force, it should encourage the ones with higher education. Since these are also the laborers with the highest productivity, however, the loss of output would be large. With respect to Moslem fertility, it should either provide more years of education to fewer Moslem females, or fewer years to more Moslem females.

Education: Wages, Labor Markets, and Professional Manpower

How efficient is the Soviet educational system in meeting manpower requirements of the economy? By adjusting wage rates and structure the leadership has been somewhat successful in creating a broad base of engineering and technical specialists (ITR). On the other hand, there is a problem of a shortfall of positions for qualified ITR in some areas at the same time as there are under-
trained ITR filling advanced positions in others. The Soviet system appears to use wage structure for both allocative and distributive functions, the former using increased wage rates to attract workers to an area of labor shortage, the latter trying to achieve some desired degree of wage equality. In the USSR when there is surplus labor, the wage structure has been distributive; when the labor market is tight, it has served an allocative purpose. The maintenance of adequate labor supply through high wages in high priority branches nonetheless appears to perpetuate a departure from the egalitarian goals pursued in the time of less strained markets.

ITR wage rates are sensitive to both the number of positions available and the supply of specialists, but neither of these seems to be sensitive to wage structure. Indeed, wages appear to play little role in output, production or technology forecasts, or in enrollment levels in professional education programs. Moreover, until recently, the heavy subsidization of education created pervasive demand for places in professional schools. The inference, therefore, is that the number of ITR slots created represents the demand side of the market for specialists, and conditions within this market do influence the wage rates of ITR.

The period of the 11th Five Year Plan will be one of extremely tight labor markets. If the pattern of the past continues to hold in the future, there will probably be a widening of the wage spread once more, and an increase in inequality. The rising relative wages of higher-wage manpower will have to be matched by increase in consumer goods production, which will be difficult in view of the reduced growth rate forecast for the Soviet economy for the next five years.

The Health Care System

The Soviet health care system is in a state of decline. Recent trends in health stock, consumption, and environment have exerted, on the whole, an unfavorable influence on the health of the Soviet population. Moreover, degenerative diseases and accidents are becoming more prevalent. Because of these developments, the magnitude of the tasks facing the health system is burgeoning.

One reason for the deterioration of such health indicators as infant mortality and male life expectancy is that the resources made available to the
health sector have not been increasing quickly enough to cope with expanding needs. In fact, the share of total health spending of the State budget has fallen substantially. Contributing to this problem is a failure to resolve decisively many long-standing issues such as the distribution of medical resources among the elderly and the rest of the population, the planning of the health system on the basis of input indicators (like beds per 10,000 population) or output indicators (like mortality data), and the unsettled conflicts between objectives -- between occupation safety requirements urged by health personnel and production targets defended by managers.

Research on the health care system pursued three additional goals. The first was the further specification of an accounting model of the Soviet health production process, and the first effort to adapt the UN system of socio-demographic accounts to Soviet conditions, to serve eventually as the data base for a Markov chain model of the Soviet health production process. The second was an effort in econometric modelling of the Soviet health care system. (The dependent variable is male life expectancy, and the causal variables include indicators of such factors as medical services, illness patterns, and environment.) The third line of research was the collection of time-series for use in model estimation. These results suggest that the approaches are fruitful and merit further work.
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INTRODUCTION AND GENERAL OBSERVATIONS

Every society is characterized by certain institutional arrangements for organizing its family life, maintaining the health of the population, educating the young, and performing other social functions. The ways in which these institutions operate depend to some degree on the society's economic system. The distinctive feature of the structure of the Soviet economic system is the use of central planning as the allocative mechanism. One of our common interests in this project is the influence of that economic mechanism on the character of its social institutions. Another aspect of this project is the application of some of the tools of economic analysis to these three social institutions: the educational and health systems and the family; that is, we are interested in the extent to which the behavior of these institutions can be explained by the principles of general economic theory employed in the analysis of market-based societies.

The term "planning" is usually applied to the organization of the economic institutions. There is a sense in which the term may be extended to the organization of the other social institutions as well. The state does seek to attain certain goals in the organization of the educational, health and family institutions, and it employs a variety of policy instruments in order to influence the activity of those institutions toward the attainment of those goals. The resource commitments and organizational policies employed for that purpose are specified in the national economic plans. The USSR may therefore be regarded not only as a planned economy but also as a planned society. The usefulness of that formulation is that while all social institutions may be regarded as planned, there is a major difference between the planning of the economy and the planning of the rest of the society. The difference is that economic planning is primarily centralized, while social planning combines centralized and decentralized planning.

The difference may be more sharply drawn by distinguishing between the planning of non-human and human resources. When a thousand Soviet enterprises produce a million pairs of shoes, that outcome is the consequence of a set of directives issued to each of the enterprises. The enterprises serve primarily as executors of decisions made earlier by the central planning authorities.
But when a thousand Soviet students apply for admission to a certain technical school, or when a thousand Soviet mothers give birth to a thousand babies, those outcomes are the consequences of decisions taken by individual persons or families. The outcomes are nevertheless planned, in the sense that the state employs a variety of devices for the purpose of influencing individual decisions in a direction consistent with the national objectives.

Strictly speaking, both centralized and decentralized methods of planning are used for both economic and social planning. In the production sector certain kinds of decentralized decisions are left to individual enterprises, and various instruments like prices are employed to influence those decisions in directions consistent with state objectives. For example, enterprises have some range of choice regarding the quality of their products, and as a method of influencing the enterprises to raise the proportion of higher quality products, they are permitted to charge higher prices for such products. On the other hand, in education and manpower organization, while individual workers are generally expected to make their own decisions on where to seek employment, the ministries have the right to assign recent graduates to specific jobs in other cities for a period of time; the allocation of labor in such cases is the result of centralized decisions rather than of the individual workers. Nevertheless, it is a fair generalization that the planning of non-human resources in the economic institutions is predominantly centralized, while the planning of human resources in the social institutions makes greater use of decentralized methods.

If one thinks of the activities of the social institutions as market-like processes, it is generally the case that centralized planning is employed on the supply side, while the demand side is generated by decentralized planning. That is to say, capacities are centrally planned — sometimes on the basis of "social demand" (the number of places in maternity wards and primary schools), sometimes on the basis of "manpower requirements" (the number of places in technical training programs of various sorts). In both cases, planning at a prior level is often employed as well: demographic policies to influence the fertility rate, for example, and educational policies to assure adequate numbers of qualified potential applicants for the training programs. The instruments by which these policies are pursued, however, will generally be of the decentralized rather than of the centralized or "command" type. The decision to have a baby or to apply to a particular educational institution remains an individual choice,
as in all modern societies, but the private costs and benefits in terms of which individual decisions are made are manipulated by the state in pursuit of its goals: by changes in maternity leave conditions, child support programs, changes in educational subsidies and in the conditions of access to different educational institutions.

The general conclusion of Western analysis of the Soviet economy is that centralized planning is highly inefficient, and the weight of opinion is that decentralization would greatly increase the efficiency of the socialized economy. It may therefore be thought to follow that social planning in the USSR, which is more decentralized, should be more efficient. Our research on the economies of social institutions was not conducted with that question in mind. It is nevertheless interesting to ask what light our research may shed on that question, which we take up in the conclusion to this introduction.

In the following sections, we will address the question: what is distinctive about the economics of our several institutions under Soviet central planning? Here we will address a different, but obviously related, question: how is the outcome, the fulfillment of the social function of the institution, affected by the authoritarian socialist setting of the USSR? This distinctive setting, it should be understood, comprises two aspects: the institutions of Soviet central planning, and the values or social goals toward which these institutions are directed. Although separable conceptually, their effects upon the social outcomes of interest to us are not always distinguishable. Therefore, when we ask how this or that non-economic institution performs differently in the Soviet Union from the way it performs, say, in the mixed capitalist economy of the United States, the possible influence of both of these and, perhaps, of other independent elements ("culture") must be recognized. In brief, we do not observe the effect of central planning alone.

**Education, Wages, and Manpower**

Our research leads us to look for differences in outcomes associated with what we have found to be a fundamental feature of the administration of these institutions in the USSR: the imperfect reconciliation of planners' and consumers' preferences, primarily by non-market means. This is seen particularly clearly in the area of education and professional manpower. That is, the centrally
determined quantity supplied (demanded) will generally not correspond, in the aggregate, to the quantity demanded (supplied) that is determined autonomously by households. The resulting disequilibrium creates a rationing problem that will usually be resolved by non-market means.

Basic industrial skills, as in the United States, are imparted primarily in programs of on-the-job training. In the Soviet Union, however, official policy for more than a decade has been to replace O-J-T with training in separate, though not completely independent, vocational schools. In the U.S., vocational schools are not a major source of skills and are not, in general, highly regarded. Why the difference in approach?

In the Soviet Union, the risk of turnover among newly trained workers and the pressure of short-term production goals have led industrial enterprises to create extremely narrow and short O-J-T programs. This means that for almost any change in job assignments the worker must be retrained. From a long-run perspective, therefore, the traditional system is of very doubtful efficiency. By removing the training programs from the direct control of production enterprises, it is hoped that program content will come to reflect prospective social benefits and costs more accurately.

Why O-J-T in the market economies has not encountered the same difficulty (at least not to the same extent) is a matter of conjecture. Recent human capital theory suggests that the answer lies in the adaptibility of the wage structure. There is evidence that in the American economy wages vary with the status of the trainee-worker in ways that permit a sharing of the costs of training between worker and employer. The trainee's share, paid in the form of reduced wages, varies directly with the external marketability of the skills being acquired. This, of course, reduces the financial risk to the employer of turnover among newly trained workers. In the Soviet Union, the data suggest, training costs are borne almost totally by the enterprise and do not vary with the external marketability of the skills involved. The result, evidently, is pressure to discourage enterprise investment in general training; both the amount and content of training are, from a social perspective, adversely affected by the wage structure within which the Soviet enterprise operates.

Post-secondary education, in general, is also distinctively utilitarian. Outside of the major service sectors (health, education), the training is
narrowly specialized, with curricula related to current production technology. Training is very heavily subsidized: with free tuition and student stipends, the private cost of higher education in the USSR must be among the very lowest in the world. The number of places in each program is determined centrally (or regionally), based upon estimates of the economy's requirements for specialists in different fields. The direct consumption value of Soviet higher education is presumably diminished by its professional orientation; nevertheless, heavy subsidization, the general credential value of the diploma, and steady growth of the population eligible for higher education (by virtue of completion of the 10th grade) have caused the demand for places generally to exceed the exogenously determined supply of places.

This contrasts interestingly with American higher education, where, at the baccalaureate level, professionalization is limited and consumption value presumably high. Subsidization is considerable, but not comparable to Soviet levels; and the supply of places, in the aggregate, is responsive to demand. These circumstances have produced the world's highest proportion of secondary school graduates going on to higher education. There is, however, no mechanism for relating the production of college graduates to changing labor market conditions other than very imperfect market signals and equally imperfect forecasts. The result, in recent years, has been a tendency to over-produce college graduates relative to the objective educational requirements of the job mix in the economy. Market effects of this system include protracted periods of job search by new graduates, displacement of high school graduates from the better paying jobs held by them, and decline in the financial return on investment in higher education.

In the Soviet case, the locus of disequilibrium is not at the graduation but at the admission stage. Excess demand for places in institutions of higher education creates a rationing problem which the Soviets attempt to resolve on meritocratic grounds: admission is by competitive examination offered by each institute. To many Soviet observers, excess demand with this form of non-market rationing is very attractive: it offers "selectivity" to the educational institutions, an assurance of student quality. Unfortunately, it also encourages students to weigh their interest in a particular program (and the career it leads to) against the probability of admission (as gauged by the size and
strength of the applicant pool). Young people are often swayed by the latter factor (better almost any diploma than none at all), and this contributes to subsequent allocation problems: many with costly, specialized education seek employment outside their field of study. This, in turn, elicits another non-market corrective: compulsory assignment of graduates to their first position for a three-year period. Clearly, neither the market-oriented American approach nor the non-market methods of the USSR offers a persuasive resolution of the very difficult social choices posed by the field of education.

Of the three social institutions we have studied, it is in the educational institutions and the related institutions for manpower management that decentralization takes forms that are most similar to markets. The demand for places in educational institutions is determined by the decisions of individual students and their families, and it is heavily influenced by the perceived benefits and costs of acquiring an additional year or more of one kind of schooling or another. The state influences the outcomes in two principal ways: by controlling the "supply," or the number of places in educational institutions, through a centralized planning method; and by setting the prices in terms of which individual benefit-cost calculations are made. The principal prices involved are wage rates and tuition. Wage rates influence educational choice in two ways: they affect (in large part) the perceived benefit of acquiring an additional year or more of a particular kind of education, in the form of the income foregone while attending school. The price of tuition consists of two parts: instructional tuition, the price of which is zero since most education is free in that respect; and the stipend that is paid to most students in technical and higher educational institutions, which is equivalent to a negative price.

One might imagine a system in which the state sought to use the instruments at its disposal — the setting of supply and relative prices — in such a manner as to attain an optimal allocation of students among places in educational institutions. It is evident, however, that the actual allocation is far from optimal. The centralized planning of the supply of places for students in technical institutions, for example, is based on enterprise estimates of their future need for specialists of all kinds. It is clear that enterprises have no incentive to economize on the use of future specialists, and that the future wage rates that will have to be paid to these specialists do not influence the
enterprises' estimates. The supply of places in specialized educational institutions is therefore likely to exceed the optimum; excessive resources are allocated to specialized education. On the demand side, the negative price of education -- because of the absence of tuition and the positive stipend -- produces a huge excess demand for admission to many educational institutions. The consequence is that a large number of students delay for several years their permanent entry into the labor force. The inefficiency of the process is compounded by an admissions procedure that permits most students to sit for the entrance examination at only one institution in any one year.

In some respects the state's ability to manipulate its policy instruments is limited by political and ideological restrictions. The policies of free tuition and student stipends are too endowed with ideological content to be treated as if they were simply value-free instruments. The possibility of varying wage rates to influence individual occupational choice is also limited by notions of an equitable distribution of income. Beyond these limitations, however, it is not clear that the state does in fact view the allocation problem as one of influencing the market-like behavior of individuals by policy instruments, or of finding a proper balance between centralized planning and decentralized managed markets. If one were comfortable with market processes, one would be cheered by a high degree of responsiveness of individuals to price and wage signals. But the responsiveness of Soviet students to such signals is often treated as if that were the problem. The Soviets seem to be of two minds about decentralized planning. One the one hand, it is regarded as entirely appropriate to offer higher wages to induce workers to acquire additional skills or to accept employment in less desirable parts of the country. In this aspect of wage policy the Soviets appear to accept an equity-based, "real cost" theory of earnings differentials. On the other hand, wage competition among enterprises for scarce grades of labor is officially condemned, largely because of its association with "excessive" turnover. The efficient allocative properties of this form of wage differentiation is not at all appreciated. Because of the unwillingness to employ wage (and price) differentiation as a means of narrowing disequilibria in such circumstances, command methods have to be employed instead.

The main difficulty, however, is the extreme complexity of the task of setting prices and wages at such levels as to elicit the desired responses. People
nevertheless do respond to them, as well as to other utility-affecting elements in the choice situation like location, availability of amenities and so forth. Such market-like behavior produces results that depart from what the state intends. Moreover, difficult as it is to understand the full complexity of behavioral relations in the production sector -- how a bonus for exported output will affect the quality of non-exported output -- it is surely much more difficult in social relations generally. In the 1960s for example, a series of measures were introduced to increase greatly the number of women choosing to enter the labor force. The measures were highly successful in what they sought to accomplish. Perhaps the framers of that policy did anticipate that one of the other consequences of those measures would be a decline in the fertility rate. One wonders, however, if there might not have been second thoughts about the female employment policy had the size of the consequent drop in fertility been fully foreseen.

Additional aspects of the interplay between centralization and decentralization emerge from our discussion of manpower planning. Our analysis suggests that the allocative, market-like role of wage structure varies with economic conditions, the tightness of labor supply in particular. During periods of abundant labor, with widespread slack in labor markets, the center successfully manipulates wage policy for primarily distributive (or equity) purposes. When labor markets tighten, relative wages play an allocative role -- influencing the distribution of workers among branches of industry. Especially relevant at this point is the fact that these allocative wage movements are, very probably, not centrally determined. They appear to represent an autonomous response of enterprise management: wage competition, often in violation of centrally set wage policy, in response to threatening labor scarcity. Thus, changes in the environment in which the decision units of the economy find themselves can influence the effectiveness of central control.

**Health**

Medical care is another field in which reliance on the market has been circumscribed in most societies; the Soviet example is distinctive in degree and direction. The utilitarian aspect that is so dominant in post-secondary education is evident in Soviet medicine as well. From its inception, the
Soviet health system has provided above average medical care to population groups perceived to be of political, economic, or strategic significance. The residual population has had access to a 'public' medical subsystem which provides basic care of a relatively low standard.

The contemporary Soviet health service can be divided into preventive and curative branches. Curative medicine is provided in either 'closed' (elite, ministerial, industrial) or 'open' (public) subsystems. In the former access to facilities is governed by place of work or status, whereas in the latter the population is assigned to polyclinics (which provide outpatient care) and hospitals on a territorial basis.

Virtually all finance for the health system comes from the state budget or profits funds of economic enterprises. There are few direct payments by patients. This method of financing has both positive and negative features. On the one hand, the absence of fee-for-service means that Soviet patients do not face a medical care price barrier, and consequently make heavy use of the system. On the other hand, the health sector is subject to relatively tight resource constraints and this has an adverse impact on patient welfare. There are many doctors but medical wages are low (and personnel predominantly female). There are many hospital beds, but the buildings which house them are spartan and inadequately maintained. Many medicines and pieces of equipment are in short supply or of poor quality. Throughout the medical sector bottlenecks exist wherever specialized, modern technology treatment is required. As one might expect, rationing by queue plays an important role in the distribution of these medical services in the public system.

Further complicating the situation is the low priority status accorded consumer oriented sectors of the 'non-productive sphere' in the USSR. They suffer most when plans are underfulfilled in other sectors of the economy. Because of this pattern, the supply to the health system of non-medical goods, such as construction materials, automobiles, and textiles is erratic and frequently insufficient.

On the basis of available evidence it appears that the avoidance of market relations and reliance on planners' preferences in the health field is a mixed blessing. This policy has produced a large system of medical care, but it is one with quantitative, qualitative, and distributional characteristics which probably deviate considerably from what would be desired by a 'voting' population. If information about high usage rates of the few legal fee-for-
service clinics and pervasiveness of 'under-the-table' payments to medical staff by patients is true, then this would indicate that Soviet consumers are prepared to allocate more resources in order to obtain care which more fully satisfied their individual needs.

It is not evident that a more decentralized system of medical care provision which involved substantial private activity would remedy the current deficiencies. But it does seem to be the case that detailed central planning and financing of medical services, or the non-market responses to the disequalibria this creates, leaves Soviet society with important, unresolved problems.

The Soviet health system, like the education system, is centralized on the supply side; the state determines the number of hospital beds and the number of medical personnel. The demand for health services, however, is determined by the decisions of individual persons and families regarding the maintenance of their health, from eating and drinking practices to the decisions to seek and accept medical care. The state influences those decisions by setting the prices that affect the benefits and costs to individuals of health-related alternatives.

There are important differences, however, in the kinds of tasks faced by the education and health systems. A major source of the complexity of the health production process is that health outputs are the result of the interaction of demographic, consumption, environmental, medical and economic factors. Therefore in order to assess the situation and performance of this social institution many different dimensions must be explored. Likewise, the development of policies and programs to ameliorate existing problems is a difficult task. The execution of a program is often impeded because of the behavior of so many variables outside the control of the Ministry of Health.

Recent trends in health stock, consumption and the environment have exerted, on the whole, an unfavorable influence on the Soviet population's health status. The illness pattern has changed substantially, with degenerative diseases and accidents becoming more prevalent. As a result, the tasks facing the health system have become more challenging.

The deterioration of certain important social indicators suggests that medical programs have not been completely effective in coping with the new illness pattern. Since the mid-1960s age-specific death rates of adult males have risen. Infant mortality began to climb in the 1970s and as a result, life expectancy at birth has fallen. Had the health system been able to compensate
for the unfavorable trends in health conditions it is possible that mortality would not have risen.

The causes of this deterioration in the nation's health are not entirely clear. We do know of several important factors, however, that adversely influence the level of health care: medical coverage is limited; a substantial amount of illness does not receive treatment. The quality of much medical care is low. Different social and political groups in the USSR have unequal access to specialized, modern medicine. Shortages of medicine, equipment and manpower are common in the system.

To a certain extent the specific problems are manifestations of a more general one: the supply of resources to the health sector by the state is insufficient relative to the needs of the population or the desires of health policy makers. During a period when tasks are becoming more complex the share of total health spending in national income has declined slightly and the health share of the state budget has fallen substantially.

It is evident that difficulties confronting Soviet society in the health field require remedial measures. However, the ability of decision makers to design and implement the required policies is limited. Four types of problems constrain effective action.

First, developments in the illness pattern cannot be controlled directly by the Ministry of Health. The aging of the population has been occurring throughout the world and inevitably brings with it an increase in degenerative disease. A certain portion of cardiovascular disease, cancer, and accidents is the product of individual behavior of Soviet citizens. Unhealthy habits, such as smoking or drinking, and inadequacies or irrationality in diets cannot be altered significantly by the activities of medical personnel. Finally, some disease is the by-product of other social and economic programs. It is argued above that mechanization, chemicalization and growing pollution have accompanied rapid industrialization and undermined health status. Obviously control of these developments is also not within the health system.

A second problem is that of confusion over objectives and appropriate measures of them. Should the health system have a preventive or curative orientation? Should the elderly, who suffer a disproportionately high percentage of serious illnesses, receive a larger share of medical services or
should care of infants and the economically active remain highest priority? Should planning of the health system remain on the basis of input indicators, such as beds or doctors per 10,000 population, or should it acquire an output orientation? None of these or other difficult issues have been resolved in the USSR.

Third, there are conflicts between objectives. Within the health sector the desire to reduce inequality in the distribution of medical services is in conflict with that of protecting the health of workers to the maximum, thereby averting illness-related production loss. Numerous examples can be found of contradictions between the aims of the Ministry of Health and those of other state organization. Health policy makers probably would like to reduce drastically sales of alcohol and tobacco products. However, those in agriculture, the food industry or retail trade, not to mention consumers, would oppose such measures. Doctors responsible for occupational health may wish to shut down an unsafe assembly line, but as this would interfere with fulfillment of production plans it can be expected that the factory management, trade unions and party branch would be reluctant to accept such a recommendation. In a socialist society conflicts between health maximization and other objectives should ideally be resolved in a rational manner by a state which reflects the population's desires and priorities. There is little evidence that the Soviet state attempts to sort out these contradictions in a coherent manner.

The final problem is that of severe resources constraints. No society allocates an unlimited amount to health protection. Nevertheless there is a tendency for the real allocation to health to grow, both on a per capita basis and as a share of national resources, in response to aging and the additional illness it generates. There are, however, few signs of a significant increase in the allocation of state resources to the health sector in the Soviet Union. With the decline in the rate of economic growth and the likely maintenance of traditional priorities there is not much scope for improvement in the immediate future. In addition, ideological constraints make it difficult to draw on available resources of consumers by expanding the private sector.

The Family

The health and education institutions are similar in that the supply side
is centrally planned while the demand side is decentralized. The family differs from both in that none of its internal processes are centrally planned. The planners decide how many teachers and doctors there will be, and what and how they will teach and heal. But they do not decide how many marriages and how many children there will be and how the parents will raise the children. In its transactions with the economy, the family and not the planners decide how much and whose labor will be supplied and what consumer goods and services will be purchased with the family's income and wealth. Thus the relationship between family and economy in the USSR is more like that in non-socialist economies than is the case in the relationship between educational and health institutions and the economy.

Although centralized planning plays virtually no role in the functioning of the institution of the family, the state has an obvious and vital interest in the kinds of decisions made in that autonomous unit. The particular decision upon which our research concentrated was the number of children to bear.

Two aspects of the fertility behavior of the population have produced grave concern on the part of the political leadership. One is the sharp decline in fertility since the late 50s, to a current level that is below the population replacement level. The second is the sharp difference in the fertility rates of Moslem and European (Slavic and Baltic) women. A number of the causes of the fertility problem are to be found in the interrelations between the family on the one hand and the health and educational institutions on the other.

The expansion of women's education has contributed in the USSR as elsewhere to the decline in fertility. We found one group of women, however, who responded to an increase in education by having more babies rather than fewer. That group consists of rural Moslem women who have no more than elementary education. When they acquire a bit of secondary education, their fertility rises (though it declines sharply if they persist through the completion of secondary school). We have interpreted that unusual response as a consequence of "premature modernization;" women who have not yet responded to those forces of modernization that cause them to wish to reduce their fertility, use the knowledge they acquire to have more rather than fewer children. The finding illustrates the point made above about the complexity of social behavior. The policy of promoting the education of Moslem girls serves as a decentralized device for accomplishing
two objectives: increasing their labor force participation and reducing their fertility. No state planner could reasonably have been expected to anticipate that the policy would have the opposite effect on the fertility decisions of one substantial group of Moslem women. Now that the underlying behavioral structure is better known, however, it is possible to design a more differentiated policy to attain the end of reducing Moslem fertility. Under that policy a given volume of educational resources would be used to give more education (through secondary school) to fewer Moslem girls, rather than less education to more Moslem girls. Educational effort would also be concentrated in the cities rather than in the countryside, because urban Moslems at all education levels respond to increased education in the usual manner, by restricting fertility.

The health system influences fertility in a variety of ways, one of which has assumed considerable prominence in the past decade -- control over infant mortality. Our research has not dealt with the impact of infant mortality on fertility, but in most countries the relationship is known to be positive: increases in infant (and child) mortality induce families to increase their fertility in order to attain the desired number of surviving children. The relatively slow decline in fertility in Central Asia therefore suggests the possibility that much of the rise of infant mortality may have occurred there, a conjecture that is supported by some other evidence.

Among the ways in which the economy influences fertility, two merit attention. One is family income. Economic theory suggests that a "pure" increase in income -- meaning by "pure" that no additional labor is required to earn that added income -- should lead to an increase in fertility. The preliminary findings of some of our research not yet completed provides some weak confirmation of that hypothesis. Provincial-level data show that the higher the level of education of males, the higher the average fertility level in the province. Since males with higher education generally earn more income, those results suggest that the higher level of "pure" income, the more children people have.

The second channel of influence of the economy on fertility operates through the cost of having children. Here we find the impact of some of the most distinctive features of the Soviet economy. The major form of that cost is the time and effort required to manage a home and care for children in the USSR,
a cost that is borne largely by the women. That high cost can be attributed in considerable measure to the system of central economic planning, for in a market economy consumer preferences would without doubt have led to a greater supply of those goods and services that would have made the mother's life easier: less queueing in shops, more prepared foods, larger apartments and so forth. That cost is greatly increased by the extremely high labor-force participation rate of Soviet women. The number of women working outside the home is now close to the demographic maximum, particularly among non-Moslem women. That high labor participation rate is a matter of state policy, designed to provide the maximum possible supply of labor to the economy. Since the future labor supply depends on the number of children being born today, however, that policy has had the consequence of providing short-run gains in the form of the maximal labor effort of women, at the cost of long-run losses in the form of a reduced future population.

The family may be thought of as engaged in two major types of transactions with the state. One is transactions in consumer goods and services, and the other is transactions in labor services. The transactions in consumer goods and services may be described in terms similar to the market-like model we have employed in the case of education and health, the supply of consumer goods is centrally controlled, while demand-side decisions are made by decentralized agents under conditions (primarily prices) influenced by state policy. In the transactions in labor services, however, the family is the supplier and the state is the demander. In this case the demand side is centrally planned while the supply decisions are made by decentralized agents under conditions (primarily wage rates) influenced by state policy.

The supply of labor services has both short-run and long-run aspects. In the short-run, the labor supply is limited by the existing population. We have dealt with some of the issues involved in the preceding discussion of education and manpower planning. In the long run the supply of labor varies with population. It is with this aspect of the institution of the family that our research has been primarily concerned.

Perhaps what is most distinctive about the economics of the Soviet family relative to other countries is the extent to which the state seeks to impose its preferences on family decision making. Many states in the world have no preferences regarding family behavior and consider it inappropriate for a state
to substitute its preferences on these matters for those of individual families. But even in those societies in which state preferences on aspects of family behavior are widely regarded as legitimate, it is rare that the efforts to impose them are as extensive as in the USSR.

There are three kinds of family activity in which the outcomes of family life in the USSR are most heavily influenced by state preferences. They are the supply of female labor services, reproductive behavior and the supply of consumer goods and services.

Soviet mothers participate in the labor force to a degree that is unparalleled among modern nations. The decision to participate or not is based on individual or family preferences, but the private costs and benefits are heavily influenced by such state policies as the promotion of women's education, subsidized child care centers, and Party-based social pressures. In this area the state has been highly successful in attaining its objectives under conditions of decentralized decision-making.

That success has been qualified, however, by certain other outcomes, largely unintended, of the high participation rate. Child behavior specialists for example have been increasingly expressing concern over the impact on young children of the maternal deprivation associated with high participation rates. Other features of family pathology like high divorce rates and juvenile delinquency have been ascribed in part to the extent of mothers' labor participation. But the major qualification is the effect of the successful labor participation on the second outcome -- reproductive behavior.

Perhaps it was unrealistic of the state leadership to expect that it could attain so high a female participation rate without a consequent decline in fertility. It is more likely that a decline was expected but that its magnitude was not. In particular, it is doubtful that when the state decision was taken around 1960 to push the female participation rate to virtually its maximum, the leadership expected that as a partial consequence the one-child family would become increasingly the norm among European Soviet women by the 1970s. Similarly, it may have been expected that the state's instruments for increasing female labor force participation would be more successful among European than among Moslem women. But it is doubtful that the leadership an-
ticipated the further consequence of a widening differential in the fertility of the two populations. Yet another looming concern is the rising ratio of retirees to active workers, a ratio that is expected to grow to alarming proportions by the beginning of the next century. The ability of the state to influence certain forms of social behavior through decentralized means ought not therefore be regarded as an unmixed blessing. The unintended spillovers into other areas of social behavior may be large and unwelcome.

The third kind of family activity that is heavily influenced by the state is the consumption of normal goods and services. While the state seeks broadly to satisfy families own preferences for consumer goods, the output mix is heavily influenced by central planning, and planners' preferences find expression in that output mix. One outcome is that Soviet families derive less utility benefit from their incomes than would be the case in a more decentralized economy. But there is another outcome that bears more directly on reproductive behavior.

In a normal market economy a rising female labor force participation rate would be accompanied by a change in the structure of demand for consumer goods and services. In particular, there would be a rapidly growing demand for goods and services that substitute for the time and effort formerly devoted by mothers to homemaking and child-care: precooked foods, better services in retail shops, freezers and washing machines, larger apartments in which to keep these appliances, fast-food shops, convenient repair services, throwaway diapers, and so forth. If consumer preferences were sovereign, the production sector would respond to the change in demand, and the greater availability of these goods and services would partially offset the loss of the mother's former homemaking and child rearing services. They would therefore cushion the decline in the fertility rate that normally accompanies a rise in the female participation rate. That is to say, the decline in fertility would be less if the production of consumer goods and services responded to the changing demand structure.

Because of the heavy influence of planners' preferences on the consumer product-mix in the USSR, however, there is no automatic response to the changing structure of the demand. Moreover the planners, being mostly men, are hardly likely to place the same value on those goods and services as do working women. Hence it is reasonable to conclude that the Soviet production section has not responded to the changing structure of demand as a market economy would. The
manifestation of that non-responsiveness is captured in the notion of the "double burden" that Soviet women are said to bear. The consequence is that the decline in fertility, which was inevitable given the high state-induced female labor participation rate, has been even greater than it would have been in a decentralized economy.

Conclusions

These observations on the three social institutions do not offer any firm conclusions on the relative efficiency of centralized and decentralized planning methods. For one thing, the planning of non-human economic resources is not easily commensurable with the planning of human resources. One should expect that the effort by the state to direct the educational and reproductive behavior of a population would be much more difficult than the effort to control the production of shoes. Therefore, the problems we have noted in Soviet social planning offer very little guidance on the question of the relative merits of centralized and decentralized methods of economic planning.

Looking only at social planning, therefore, one must be impressed with the responsiveness of Soviet people to variations in the conditions under which decisions are made. Education decisions are strongly influenced by the perceived benefits and costs of education, and childbearing decisions are strongly influenced by women's wage rates. Such strong market-like responses by individuals offer an opportunity to Soviet policy-makers to guide their behavior in directions desired by the state. On the other hand, we have noted a variety of sharp limitations on the ability of social planners to accomplish that end. Ideological factors limit the range of possible price and wage variations. But more important is the difficulty of determining the set of prices that will lead individuals to choose the desired alternatives. The responsiveness of individual behavior facilitates the operation of real markets, but does not assure the effectiveness of the market-like instruments employed in Soviet social planning.

The general conclusion is that in such social institutions as the family, education, and health, Soviet citizens are similar to those in other countries in that they are generally free to choose among a variety of alternatives, on the basis of their own calculus of the private costs and benefits. They differ from citizens in other countries, however, in their lesser ability to
influence the volume of resources available to them (education, consumer goods), and in the greater extent to which their government manipulates the prices that determine the private costs and benefits. The Soviet state has the capability of greatly influencing social behavior by the centralized control over resources and its decentralized instruments of policy. But it is not at all clear that the state is any more successful or efficient in attaining its goals with respect to social institutions than in attaining its goals in the economy.
INTRODUCTION

1. The subject of this report is the role of market institutions—the wage system, in particular—in the production and allocation of human capital in the Soviet Union. This has been a matter of controversy among Western specialists on the Soviet economy for some time.¹ Some argue that relative wages play a substantial allocative role: that relative wages respond over time to changing relative scarcities of different grades of labor, that employers respond to changing relative wage ratio in staffing decisions, and that students and workers respond to financial costs and benefits (including wages) in choosing occupations and courses of professional instruction. This view builds upon two central phenomena: the substantial degree of mobility enjoyed by labor in the USSR (and the "ultimate sanction", as J.R. Hicks put it², that this allows labor to impose upon wage structure) and, on the other side of the wage bargain, the pressure to economize in the use of labor that exists at the enterprise level.

The facts of the matter allow of a different interpretation as well. Mobility of labor, especially between regions, is subject to major impediments.² The economizing tendency of employers is undermined by dysfunctional incentive systems. Wage structure, it is argued, is controlled centrally with distributive and ideological objectives predominant. At best, relative wages signal long-term priorities (such as for regional development); a reasonably flexible instrument for efficient allocation of labor they are not. Discernible trends in wage structure should therefore be associated with distributive or equity policy of the State rather than with efficient signalling of changing relative scarcities.
2. The actual and potential roles of wage structure in the Soviet economy are questions of considerable interest today. The Soviet economy is entering upon a period of manpower stringency: increments to the population in the working ages are forecast to decline from about 2.7 million in 1976 to only 285,000 in 1985-86.\textsuperscript{4} Tightness of aggregate labor supply is accompanied by severe regional imbalances as well. The allocative agenda is therefore substantial, and the mechanisms through which it will be pursued remain unclear. As growth of aggregate labor supply ceases to be a source of economic growth, as improved allocation of existing stocks is relied upon more heavily, the institutions for allocation assume additional importance.

Many institutional alternatives exist, both in theory and in Soviet practice. It is possible, however, to capture an essential aspect of the situation in two broad sets of alternatives: "administrative" or command procedures and market-based approaches in which private incentives are manipulated to produce the desired allocation. As efficient allocation (defined with reference to centrally determined production goals) becomes more vital, especially in a society in which the sectoral and regional growth plans of the center contrast sharply with the occupational, educational, and locational preferences of the majority of the population, the tension between coercive and voluntaristic allocation increases. The ability of the latter to cope with the enormous allocative tasks that exist without violating distributive or other constraints (such as on the division of GNP between
consumption, investment, and defense) may be very limited.

Past experience may illuminate the prospects for alternative approaches. During the postwar period, the Soviet economy has experienced two severe cycles in aggregate manpower supply. These cycles reflect the impact of major demographic episodes of the past (such as war losses) and the steep fertility decline that began in the early 1960's. The first cycle reached a peak in 1954, with an annual increment to the working age population of 2.8 million persons; the trough came in 1960, when there occurred a net decrease of 150,000 in the size of this population.\(^5\) (In Soviet practice, the working ages are 16 to 59 for males and 16-54 for females.) The second cycle has the 1976 peak and 1986 trough already referred to.

The effect of these cycles is to cause sharp changes in general labor market conditions within relatively short time periods. At the same time, major shifts in the structure of employment have occurred, between major sectors of the economy—industry, agriculture, the services—and within the industrial sector (manufacturing and mining). Compositional change has occurred as well in qualitative aspects of the labor force: educational attainment in general and the supply of formally trained professional manpower in particular, have increased markedly. This combination of sharp swings in aggregate labor supply and substantial, structural and qualitative changes signifies major changes in relative scarcities of different types and grades of labor. If market forces, operating through the wage structure, play an important role in manpower allocation in the USSR, postwar Soviet
history would seem to have provided a background against which those forces should be discernible. What we discover about the allocative role of wage structure in the recent Soviet past may inform our speculation concerning Soviet response to the straitened manpower situation upon which it is now entering.

3. The empirical basis of our analysis of Soviet labor markets is the changing wage and employment structure over the period 1950-1978. The structures we explore involve disaggregation by branch of the economy and by major professional category: Rabočiiye (blue-collar workers), ITR's (engineering-technical personnel), and Sluzhashchiye (office and clerical workers). Over the period in question, the wage structure of these three professional groups has been substantially compressed in the sectors (Industry, Construction, and State Agriculture) for which we have sufficiently disaggregated data: the average wage rates of sluzhashchiye and of rabočiiye have risen sharply relative to that of the highest paid group, ITR's. Focusing upon rabočiiye and ITR's, as we will in much of what follows, we find the following: In Soviet industry as a whole, the ratio of the average rabočiiye wage, $W(R)$, to the average ITR wage, $W(I)$, increased from .57 in 1950 to .85 in 1978. 6 In construction ("basic construction", excluding subsidiary manufacturing, transport, and service operations of construction enterprises), the increase is even more striking—from .47 in 1950 to .93 in 1978. (Reference is to average monthly money wages, including all bonuses and premia paid out of the enterprise wage
fund. Excluded are those, apparently negligible, bonuses paid from other sources.) Average rabochiy wage rates also rose substantially relative to those of sluzhashchiye in all branches of industry for which we have data during this time period.

The effect of these wage changes was to reduce sharply the relative variation in average wage levels among labor force categories. The extent of the compression of this aspect of wage structure can be gauged from the change in the following measure: the ratio of the absolute difference between the wages of the highest and lowest paid groups to the mean wage of all personnel. In industry, this ratio decreased from .814 in 1950 to .372 in 1978. During the period for which the required data are available for individual branches of industry (1950-66), the same tendency is observed in branch disaggregation.

These changes in wage structure involve substantial changes in the economic positions of different educational groups. According to the 1970 population census, of all of the persons recorded as ITR's, 85.2 per cent had at least a complete secondary education and 78.4 per cent had a specialized secondary, partial or complete higher education. Data are provided for all rabochyiye in industry, but some idea of the disparity in educational attainment can be gained from the data given on those engaged in "physical work" in machine building and metal working, a relatively well-educated branch of industry: 31.1 per cent had a complete secondary education or more, and 5.7 per cent had a specialized secondary, partial or complete higher education.
Sluzhashchiye generally have an intermediate level of education. Comparable percentages for typists and stenographers, apparently the least well educated major occupational group in the sluzhashchiy category, were 59.7 and 8.4. Thus, it is evident that, over the 1950-78 period, money wage rates increased in inverse relationship to the average educational level of these three major occupational categories.

This relationship is the point of departure for our exploration of the functioning of Soviet labor markets and the reflection of changing relative scarcities in the structure of Soviet wages. There can be no doubt concerning the enormous increase in supply of "upper level" or professional manpower in the Soviet economy. Between 1950 and 1978, the number of "specialists" (i.e., holders of diplomas from higher educational institutions, VUZy, and specialized secondary institutions, SSUZy, of which the tekhnikum is the most common form employed in the economy increased by 700 per cent, while total employment grew by about 50 per cent. In industry, construction, and other branches of material production, the growth rate of specialist employment has been much greater: Between 1955 and 1977, the number of specialists employed in industry increased by more than 750 per cent; in construction the increase exceeded 900 per cent. These growth rates may be compared to a figure of 390 per cent for the Soviet economy as a whole over the same time period. As proportions of total employment, the growth of specialist employement is even more striking: In industry and construction, the increase is from about 4 per cent in 1950 to 18-21 per cent in 1978.
4. That such striking increases in absolute and relative supply of "high eds" in material production should have something to do with the decrease in the relative wage levels of the two white collar labor categories (relative to the much less well educated blue collar group) will strike most economists as an eminently reasonable suggestion. Nevertheless, a number of factors must be considered before this explanation is accepted as adequate. These factors relate to movements of demand for "high eds" during the postwar period, the peculiar micro-economics of demand for specialists in Soviet production enterprises, and to the functioning of markets for professional labor more generally.

Consider first the question of demand. The fact that the supply of professional manpower to, and the employment of ITRs in, Soviet production branches have grown rapidly does not by itself imply downward pressure on the relative wage ratio of the occupational groups involved even in a competitive market setting. Before any inference can be drawn concerning direction of changes in equilibrium wage rates, we must know something about demand conditions during the time period in question. One of the early findings of the economics of education in the United States is the apparent stability of the rate of return to investment in college education over a lengthy period in the twentieth century when the (relative) supply of college graduates in the American labor force increased steadily and substantially. The conventional explanation is that, reflecting changes in the structure of economic activity and the pace of technical change in the economy, demand for
college-trained people was also increasing rapidly, and that this prevented any significant decline in the rate of return on a college degree.

This evidence on the role of demand changes poses an obvious question concerning the Soviet case: What was the role of demand? Is it clear that the supply of "high-eds" was increasing more rapidly than demand for their services during this period, which incorporated subperiods of rapid expansion and technical change? Given the rapid pace of investment in much of this period, given the weight of the more "progressive" branches (energy, machine building, chemicals) in postwar Soviet industrial growth, and the rising sophistication of production methods in the rapidly expanding branches, one might well infer that demand for technically trained professionals was increasing strongly, perhaps sufficiently strongly to render unlikely the sharp change in relative earnings shown by the official data for ITRs and rabochyiye.

The workings of labor market institutions must also be considered. The main focus of our attention will be upon the sharp change in the relative earnings of ITRs since 1950. It is this change that is the main evidence on the role of changing relative scarcities (of "high eds" and "low eds") in shaping the Soviet wage structure. Now, it must be understood that the term ITR properly refers to a position in an enterprise's table of organization, not to the person, or any qualitative aspect of the person, who occupies that position. The
wage rate associated with the position is determined with reference primarily to the extent of the responsibilities it involves (and/or to the number of persons supervised), and job content is determined by the technology and organization of production that prevail in the enterprise. Traditionally, there have been no advanced educational prerequisites for ITR slots—neither for lower level "technician" slots or higher level "engineer" positions. Apparently, people have been selected for those positions based upon general educational attainment, work experience, successful completion of special training programs provided by the enterprise, and specialized advanced training in SSUZy (for technician slots) or VUZy (for engineer slots). (Recent years have seen substantial efforts in many branches to upgrade educational attainment among ITRs, including the replacement of those lacking a VUZ or SSUZ diploma (the so-called "praktiki") with holders of these credentials. Nevertheless, major reliance has been placed upon other background characteristics and upon training for the position within the employing enterprise.)

This suggests that the conventional neoclassical labor market model may not be immediately relevant to the ITR wage phenomenon. ITRs may differ from carpenters or typists in that they do not represent one or several more or less homogeneous skill categories, which skills are acquired before labor market entry. If the ITRs' skills are highly specific to the individual enterprise (reflecting that enterprise's product mix, technology, and organization of production) and are largely acquired within the enterprise, we may be misled
by a model which associates ITRs with skills that are bought and sold in labor markets. Put differently, the long-term decline in the relative earnings of ITRs should not (perhaps) be associated with an increase in the supply of ITRs (relative to demand), because ITRs are enterprise-specific positions, not widely transferrable skills for which a market can be said to exist.

An alternative approach would emphasize the extent to which the technical and managerial skills of the ITRs are transferrable, commanding value in a substantial variety of employments. Whether these skills are acquired in enterprise-administered training programs, on the job, in independent SSUZ or VUZ attended before employment, or in some combination of these alternatives, ITRs (in this view) can be treated as an occupational group (or as a number of such groups). Conventional neoclassical supply and demand analysis can then be applied to movements in the (equilibrium) price and quantity of ITR services.

A very similar opposition of conceptions of contemporary labor markets has emerged in Western labor economics. On the one hand, we have the orthodox neoclassical view, characterized by labor markets for well-defined skills which are acquired before labor market entry. Allowing for adjustment lags and market imperfections, wages tend toward market clearing levels as suppliers (actual and prospective sellers of different skills) and demanders (profit-maximizing employers) make short- and long-run responses to relative wage rates for different skills.
The rival conception combines the ideas of modern institutionalists such as Clark Kerr, Melvin Reder, Piore and Doeringer, Lucas and Thurow. The main ideas are:

(a) The major part of job-required skills are acquired on-the-job, after hiring, not before.

(b) The structure of the table of organization and job content are largely determined by the technology of production.

(c) Wage differentials and promotion criteria are strongly influenced by conventional notions of equity. The former are commonly based upon the complexity of job content and the latter upon seniority.

(d) The wage structure responds very slowly to changes in market conditions, and then only to progressive, long-term shifts. Shorter run changes in relative scarcities have virtually no effect on relative wages: Employers react by varying recruitment efforts, hiring standards, and/or training programs. In the "internal labor market" of the large enterprise, wage structure represents a body of understandings and expectations that is not substantially altered without cost.

(e) Given the table of organization, job content, wage structure and the reliance on training within the firm, queues form for positions at different levels. The order in which people are hired (i.e., position in the queue) is determined by prospective training costs as estimated by the employer. These estimates are based on "signals" (as Spence calls them)
background characteristics, of which educational attainment is assumed to be the most important. In apparently significant aspects, the latter model (approximately Lester Thurow's "job competition" model)\(^{16}\) reproduces Soviet labor market conditions, especially those relating to technicians and engineers:

(a) The literature on manpower planning makes evident that tables of organization at the ITR level are designed on the basis of "normative coefficients", relating ITR slots of different sorts to blue collar staff levels or to output levels, with account being taken of the technical level of the enterprise. No indication has been found that, given the technology of the enterprise, the table of organization is influenced by relative wage rates. Nor is there any suggestion that the technology of production is selected with reference to the relative scarcities or wage rates of different grades of labor. (Piore and Doeringer find no evidence of such sensitivity in U.S. firms.)\(^{17}\) This dominant role of fixed coefficient planning, with emphasis on technical characteristics of the production process, imply very low wage elasticity, as implicit in the second model.

(b) A second important aspect is the existence of a centrally determined wage structure, subject to "reform" at lengthy
intervals. In this structure, wage rates are assigned to different slots as previously indicated—on the basis of job "complexity" and/or the extent of supervisory responsibilities. Again, descriptions of the wage-setting process assign no explicit role to relative scarcities. Technical aspects dominate the process.

(c) For most of the postwar period, primary reliance has been placed upon training within the enterprise to produce the desired skill mix, at both the blue collar and professional levels. Seniority is accepted as a major determinant of promotion.

5. The import of these considerations is that institutional considerations complicate the relationship between changing relative scarcities and changing relative wages. If the number and content of ITR slots are determined independently of relative wages, if relative wages are so strongly influenced by institutional factors, it is no longer evident that the enlarged supply of SSUZ and VUZ graduates did cause or even could have caused such striking changes in relative wages over relatively short periods of time. If, through on-the-job training or through the planned professional manpower supply system (which purport to link enrollment levels in SSUZy and VUZy to staffing requirements of Soviet enterprises) demand for professionals creates its own supply, it is not clear how supply can so substantially outpace demand as to produce the remarkable change in wage structure that has occurred. If the vastly
increased supply of graduates means only that ITRs receive more of their preparation for their assignments in formal educational institutions before going to work and less of it at the enterprise after accepting employment, the source of substantial downward pressure on ITR wages (relative to rabochiy wages) is not clear. It should be emphasized that the revolution in educational attainment which we are discussing involved much of this sort of substitution, as opposed to net increase in the population of ITRs. The enormous increases (already described) in the numbers of VUZ and SSUZ graduates employed in Soviet industry, 1950-78, translate into an increase from 10.4 to 16.4 per cent in the ratio of ITRs to total employment. Is it self-evident that a change of this magnitude should lower the average wage ratio of ITRs from 178 per cent to 118 per cent of that of blue collar workers? This question, as we have indicated, seems the more apt when we consider factors that were operating to increase demand for ITRs relative to blue-collar workers: technological progress in most branches of Soviet industry and disproportionate growth of technically advanced branches in which the ratio of ITRs to rabochiy is relatively high.

A third factor, related to the institutional elements just discussed, and bearing upon the linkage between relative scarcities and relative wage rates, is the microeconomics of the employment decision. In the preceding paragraphs we have indicated the basis for skepticism concerning the wage elasticity of demand for labor of different grades. The roles of technologically and institutionally imposed constraints were stressed. Within the framework of these
constraints, the underlying thrust of the enterprise toward profit maximization (or cost minimization for any given output level) was taken for granted. (An exception is suggested by the evidence, of a not very persuasive nature, of Doeringer and Piore that American engineers take account of average wage rates, but not of relative wage rates of different categories of labor, in designing new facilities. 18 ) There are grounds for suspecting that this fundamental economizing tendency is, in an important aspect of employment decision-making, very weak if not oppositely directed in the Soviet enterprise. The point is that the Soviet enterprise has strong incentives to seek a larger rather than a smaller wage bill (or approved wage fund). 19 The managerial wage scale and important bonuses vary directly with the size of the wage fund that has been approved by higher organs (i.e., the Ministry) and incorporated into the enterprise's annual plan. Enterprises are widely reported to respond to this circumstance with efforts to enlarge staff and to upgrade the table of organization—requesting engineer slots when technicians might serve as well, etc. It is also possible that enterprises which are finding it difficult to meet requirements for skilled blue collar workers attempt to reclassify highly skilled operative positions as ITR slots. (In succeeding sections, we shall be considering the changing relationships between the average wage rates of different categories of labor in different sectors of the economy. It may be appropriate at this point to observe that behavior of the sort described may affect wage relationships in ways
that, in some cases, are not immediately obvious. For example, upgrading the ITR staff would obviously raise the average ITR wage, $W(I)$, and decrease the ratio of average rabochiy wage, $W(R)$, to $W(I)$. Expansion of the ITR staff would do the opposite if, as seems likely, it principally involved addition of slots at the lower (technician) level. Transfer of upper level rabochiy slots to lower level ITR slots would tend to lower the mean values of both $W(I)$ and $W(R)$, raise the mean wage for both groups taken together, and very probably lower the ratio, $W(R)/W(I)$. This last surmise follows from the assumption that the ITR wage distribution is relatively dense at the lower (technician) end and the rabochiy wage distribution is relatively thin at the upper (highly skilled) end. Shift of a slot from the best paid rabochiy group to the lower tail of the ITR distribution could have these effects if the newly created ITR slot does indeed pay more than the rabochiy slot which was eliminated. We assume that this is the case because, by hypothesis, we are dealing with practices whereby enterprise managers attempt to increase their total wage funds. Possibilities such as this should be kept in mind when considering the effects of employment changes on relative wages, as we will be doing.)

Officials at higher levels, of course, are aware of this sort of behavior and have ways of opposing it. Nevertheless, the literature suggests that their efforts have not been entirely successful, and that professional staffs at production enterprises tend to be larger and more costly than they would be in the absence of the dysfunctional
incentive to which we have referred. Therefore, at a very consequential level of employment decision-making—that relating to determination of the size of the enterprise wage fund—we do not anticipate the consistent, conscientious economizing tendency that, in the aggregate, causes relative wages to adjust to relative scarcities.

Shorter run behavior is another matter. Given its (approved) wage fund, the typically strong pressure to meet production targets presumably generates equally strong pressure to expend the wage fund in a manner which is (privately) efficient. In this regard, it should be noted that, in Soviet economic administration, the enterprise wage fund represents the most effective, the principal means of control of enterprise behavior in the field of employment: once approved, violation of the ceiling it represents is not easily justified and, if not justified, is severely penalized.

This implies a tendency to expend the wage fund so as to attract and retain the staff which is required to meet production targets. And this will involve "meeting the market" for labor of different grades, sometimes by means which are not officially approved (such as "adjusting" locally-controlled output norms and upgrading of workers or their positions) but which do not violate the wage fund ceiling. Under these circumstances, increasing (relative) supply of "high-ed" manpower would be translated into reduced pressure to "drift" ITR wages upward. ITR wages would tend to rise less rapidly than those of labor force categories (such as skilled rabochiye) in greater scarcity.
6. The foregoing discussion leads us to conclude that the conventional link between the greatly increased stock of SSUZ and VUZ graduates in Soviet economy and the decrease in the earnings of ITRs and sluzhashchiye in the production sector relative to those of blue collar workers is subject to question on several grounds. First, it neglects the probably substantial growth of demand for professionally trained manpower over the period in question. Second, it seems implicitly to accept a neoclassical view of labor market operation, in which production skills are priced and allocated by the interaction of buyers and sellers who respond flexibly to changing relative scarcities and prices. An alternative view emphasizes the rigidities in industrial wage structures, the importance of occupational training provided by the employer after hiring decisions are made, and the role of educational attainment in the employer's ranking of prospective employees. Third, we observed that the reward structure of the Soviet enterprise generates both incentives and disincentives for efficient staffing decisions. The implicit assumption of the neoclassical model that the firm will tend to produce whatever output(s) it decides upon at the lowest attainable total cost is subject, in the Soviet context, to important qualification. Finally, there is ample evidence that distributive considerations have had a substantial influence upon Soviet wage structure. Changes designed to reduce earnings differentials often coincide with shifts in relative scarcities, posing a central analytic problem in the discussion that follows.
In the following sections, we attempt to shed light upon these issues by examining, in differing degrees of disaggregation, Soviet wage, employment, and educational data for the period 1950-1978. Our method, essentially, is to identify apparently substantial trends or tendencies in the relationships among these variables and to evaluate their consistency with the operation of labor markets which play a substantial allocative role.

This attempt to make sense of wage and manpower movements is subject to serious drawbacks. Most important, perhaps, is the degree of aggregation of most of the data we will use: using national data for sectors of the economy or even for 16 or 17 branches of industry, the effects of changes in the regional or product composition of the branch aggregates is lost to us. Adjustment lags are also unknown; we can only hope that the time horizons over which we observe wage and employment changes are sufficiently long that all fundamental relationships have had ample opportunity to work themselves out. Finally, we might note that our objective of relating changes in relative scarcities of different grades of labor to changes in relative wage rates would be especially well served by information relating specifically to newly hired personnel: the levels at which they were hired and the associated wage rates. Such data being totally unavailable, we make use instead of movements in total employment and in the average wage level for all personnel in the particular category in question.

This brief list by no means exhausts the problems posed by the incomplete, highly aggregated data set with which we will work. In attempting the following analysis, we implicitly assume that the
swings in labor market conditions that occurred in the 1950-78 period were so substantial and so unevenly distributed over this time period that they would make themselves felt in our wage data if, indeed, wage structure served to accommodate the economy to changing relative scarcities of different grades of labor.
II. MAJOR TRENDS, 1950-78

1. In this section, we examine wage and employment developments in industry as a whole over the 1950-78 period. During this period, the number of white collar workers (ITR's plus слу́шашчи́ве) per 100 blue collar workers in industry increased from 16.5 to 20.7. The relative wage of white collar workers decreased from 143.6 to 110.5 per cent of the average wage of blue collar workers.

What we take as our primary hypothesis associates these changes with sharply reduced relative scarcity of persons with white collar skills. Whether produced by decentralized market behavior or by efficiency-minded central planners, the inverse movement of factor proportions and of relative factor prices represents rational adaptation to altered relative scarcities. Thus, relative wage rates are seen as playing an allocative role, serving as efficient signals to both suppliers and demanders of factor services. (The notion that relative wages play a substantial allocative role would appear to be implicit in the notion that they vary with changing relative scarcities. If market forces cause equilibrating changes in relative prices, those forces presumably reflect economizing behavior by actors in the market. If the equilibrating changes represent decisions by price administrators at the center, their effort to track equilibrium price relationships presumably has an allocative purpose which is justified by an allocative effect. Therefore, those who posit a relationship between relative scarcities and relative wages would also tend to assign an allocative role to relative wages.)
Table 1. Average monthly wage rates (rubles per month) and employment indices, Soviet industry: 1950-78*

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<tbody>
<tr>
<td>Rabochiye (r./mo.)</td>
<td>68.7</td>
<td>76.2</td>
<td>89.8</td>
<td>101.7</td>
<td>130.6</td>
<td>160.9</td>
<td>176.1</td>
</tr>
<tr>
<td>Index (1950 = 100)</td>
<td>100.0</td>
<td>110.9</td>
<td>130.7</td>
<td>148.0</td>
<td>190.1</td>
<td>234.2</td>
<td>256.3</td>
</tr>
<tr>
<td>ITRs (r./mo.)</td>
<td>120.8</td>
<td>126.4</td>
<td>133.0</td>
<td>148.4</td>
<td>178.0</td>
<td>199.2</td>
<td>208.4</td>
</tr>
<tr>
<td>Index (1950 = 100)</td>
<td>100.0</td>
<td>104.6</td>
<td>110.1</td>
<td>122.9</td>
<td>147.3</td>
<td>164.9</td>
<td>172.5</td>
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<tr>
<td>Sluzhashchiye (r./mo.)</td>
<td>63.6</td>
<td>67.8</td>
<td>73.2</td>
<td>85.8</td>
<td>111.6</td>
<td>131.3</td>
<td>142.7</td>
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<tr>
<td>Index (1950 = 100)</td>
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<td>106.6</td>
<td>115.1</td>
<td>134.9</td>
<td>175.5</td>
<td>206.5</td>
<td>224.4</td>
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<tr>
<td>Ratio: Line 1 ÷ Line 3</td>
<td>.569</td>
<td>.603</td>
<td>.675</td>
<td>.685</td>
<td>.734</td>
<td>.808</td>
<td>.845</td>
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<tr>
<td>Rabochiye: Index (1950 = 100)</td>
<td>100.0</td>
<td>127.0</td>
<td>150.3</td>
<td>183.3</td>
<td>207.5</td>
<td>222.6</td>
<td>233.9</td>
</tr>
<tr>
<td>ITRs: Index (1950 = 100)</td>
<td>100.0</td>
<td>129.0</td>
<td>157.2</td>
<td>224.9</td>
<td>288.7</td>
<td>335.7</td>
<td>377.1</td>
</tr>
<tr>
<td>Sluzhashchiye: Index (1950 = 100)</td>
<td>100.0</td>
<td>105.3</td>
<td>113.0</td>
<td>136.0</td>
<td>160.6</td>
<td>161.3</td>
<td>159.9</td>
</tr>
<tr>
<td>ITRs per 100 Rabochiye</td>
<td>10.4</td>
<td>10.6</td>
<td>10.8</td>
<td>12.9</td>
<td>14.1</td>
<td>15.3</td>
<td>16.4</td>
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Sources: TsSu SSSR, Trud v SSSR (Labor in the USSR), Moscow, 1968, pp. 81, 140; TsSU SSSR, Narodnoye khozyaystvo SSSR v 19 godu, statisticheskiy yezhegodnik (The Economy of the USSR in 19, A Statistical Annual), Moscow, 1960-78. Volumes in this series that were used are those for 1965, 1970, 1975, and 1978. (Employment and wage data from these volumes occasionally differ slightly.)

* Data refer to average annual employment of industrial-production personnel only. Rabochiye are blue-collar workers; ITRs are engineering and technical personnel; Sluzhashchiye are office and clerical workers.
Table 2. Average annual percentage rates of change of wage rates and employment levels, Soviet industry: 1950-78

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<tr>
<td>Rabochiye</td>
<td>2.00</td>
<td>3.36</td>
<td>2.50</td>
<td>5.13</td>
<td>4.26</td>
<td>3.05</td>
<td>3.42</td>
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<tr>
<td>ITRs</td>
<td>0.56</td>
<td>1.43</td>
<td>1.81</td>
<td>3.70</td>
<td>2.28</td>
<td>1.52</td>
<td>1.97</td>
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<tr>
<td>Sluzhashchiye</td>
<td>1.07</td>
<td>1.71</td>
<td>3.06</td>
<td>5.40</td>
<td>3.30</td>
<td>2.81</td>
<td>2.93</td>
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<tr>
<td>Rab.:ITR ratio*</td>
<td>1.17</td>
<td>2.28</td>
<td>0.82</td>
<td>0.87</td>
<td>1.94</td>
<td>1.50</td>
<td>1.42</td>
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<tbody>
<tr>
<td>Rabochiye</td>
<td>4.89</td>
<td>3.66</td>
<td>3.64</td>
<td>2.57</td>
<td>1.42</td>
<td>1.70</td>
<td>3.08</td>
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<tr>
<td>ITRs</td>
<td>5.22</td>
<td>4.04</td>
<td>7.33</td>
<td>5.12</td>
<td>3.06</td>
<td>3.95</td>
<td>4.85</td>
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<tr>
<td>Sluzhashchiye</td>
<td>1.04</td>
<td>1.42</td>
<td>3.67</td>
<td>3.38</td>
<td>0.09</td>
<td>-0.26</td>
<td>1.69</td>
</tr>
<tr>
<td>ITR:Rab. ratio**</td>
<td>0.29</td>
<td>0.37</td>
<td>3.62</td>
<td>1.79</td>
<td>1.65</td>
<td>2.34</td>
<td>1.64</td>
</tr>
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* Average annual percentage change in the ratio of average **rabochiy** wage to average ITR wage.

** Average annual percentage change in the ratio of ITR employment to **rabochiy** employment.

Sources: See Table 1.
As we indicated in the preceding section, this interpretation of the increase in the ratio of blue collar to white collar wages involves more than relatively rapid rightward shift in the supply curve of professionally qualified manpower. Not only must we reckon with the evidence that demand for such labor increased rapidly over this time period; we must also consider developments in the market(s) for blue collar labor.

2. The available evidence does appear to support the view that changing market relationships contributed to the relative wage changes mentioned above; those relationships did indeed shift in ways consistent with the observed change in wage structure. The evidence we refer to includes the following:

(a) There has occurred an enormous increase in the absolute and relative supply of VUZ and SSUZ graduates, especially in industrial specialties. Over the period 1950-78, the number of SSUZ and VUZ graduates employed in the entire Soviet economy increased at an annual average rate of 7.8 per cent p.a. In Industry, the growth rate was in excess of 10 per cent p.a. (1955-1977). Over the same period, the number of blue collar workers grew at a rate of only 3.1 per cent p.a. Perhaps most telling, the number of white collar positions in industry grew at an annual average rate of 3.9 per cent p.a. Adding in all of those who developed the necessary qualifications for these professional positions by other means (training programs on the job, etc.), it is evident that the number of persons qualified for professional positions in Soviet industry has grown much more
rapidly than has the number of such positions. It might also be noted that the massive expansion in complete secondary education has greatly altered the distribution of aspirations among younger members of the Soviet industrial labor force. The proportion that feels itself qualified for and aspires to white collar work has increased greatly: the proportion that accepts the prospect of a blue collar career has shrunk. This effect of educational attainment upon expectations, combined with the slow pace at which job content has progressed in the direction of greater complexity, has produced morale, turnover, and supply problems at the blue collar level which receive frequent comment in the Soviet press.\(^1\)

(b) The Soviet system of planning for professional manpower begins with requests or requisitions (zayavki) submitted by employer enterprises.\(^2\) Based upon forecasts of their prospective needs for specialists in different fields and levels, enterprises estimate the net additions to staff they will have to make over a five-year time horizon. Collated over enterprises and ministries, zayavki are converted into enrollment plans for SSUZy and VUZy. On paper, at least, the system would appear to offer prospects of avoiding the gross imbalances of supply and demand which characterize markets for so many professionals in the U.S. In practice, however, the system is defective in several important ways. Most relevant at this point is the system's bias toward overestimation of prospective demands.\(^3\) Bearing no financial responsibility for the training they are signalling, not even being obligated to employ the professionals they have asked to have trained, there is a tendency to abuse the system. Inflated requests are submitted, especially for engineering
specialties which the enterprise uses extensively. In part this behavior represents "hoarding in advance"—an effort to assure an ample supply and, perhaps, a measure of selectivity among applicants. It also appears to be related to enterprise efforts to upgrade the table of organization, as discussed previously. The effect is to undermine the system's ability to maintain a moving balance between demand and supply, both in the aggregate and by level and field of specialization. Despite efforts by manpower planners to counteract these biases, it is commonly conceded in the Soviet literature that flaws in the zayavka system contribute to overproduction of specialists in the U.S.S.R.

(c) Recent years have brought numerous explicit references to the overproduction, or excess supply, of engineers in many specialties. Attention is called to the very high ratios of engineers and technicians to blue collar workers that distinguish major branches of Soviet manufacturing from their counterparts in Western Europe and the United States. The increasingly frequent employment of engineers and technicians in blue collar slots presumably also reflects shifts in relative scarcities, at least on a regional basis. In some cases this phenomenon is justified as a natural and desirable consequence of the "scientific-technical revolution" that the Soviet economy is said to be experiencing. Whatever merit there may be in this explanation, other factors appear to be more significant: anomalies in the wage structure which allow the professional higher earnings as a skilled rabochiy than as an ITR and local imbalances between demand and supply of specialists (i.e., lack of vacancies in specific profesional specialties).
(d) Especially telling evidence of growing relative supply during this period is provided by the behavior of manpower administrators and of employers. The Soviet economic press calls frequent attention to the negligence of many employers in fulfilling their obligations to newly hired young specialists. Work within their field of specialization, housing and other amenities are often not provided. (These failures release the young specialist from obligatory assignment to the enterprise, if the specialist is employed under such assignment.) The resulting turnover of young specialists is said to be of little concern to enterprise managers because of the ease with which replacements can be found, if they are in fact needed.

(e) Growing slack in the market for specialists is also indicated by the widespread non-enforcement of the compulsory three-year job assignments to which newly graduated specialists are subject by law. In many specialties, both industrial and other, the regulation is so commonly and easily evaded as to render suspect the economic rationale of the assignment regulation at this level: Employers either do not need it to meet their needs for specialists or they prefer to take their chances on finding in the open market employees whose service at the enterprise is free of compulsion.

Evidence such as this represents strong support for the view that, during the 1950-78 period, the supply of professionals specialized to material production and of those whose complete general secondary education qualified them for white collar employment has increased substantially more rapidly than has demand for such services.
Furthermore, the evidence—employment of diploma holders as blue collar workers, the expansion of vocational school programs at the expense of complete general secondary education (the main path to higher education in the U.S.S.R.), the increasing resort to "administrative measures" and "organized recruitment" in the assignment of young labor force entrants at the rabochiy level—strongly suggests that the scarcity of potential professionals has decreased substantially in comparison with the scarcity of would-be blue collar workers.

Such generalizations, we realize, must be viewed with some caution. Regional variation has been neglected and what is true of some specialties is not true of others. Nevertheless, we feel that certain directions of change over the past 30 years can safely be inferred from the available evidence. One is toward substantially reduced relative scarcity of "high eds" relative to "low eds", of those qualified for and aspiring to ITR and sluzhashchiy positions relative to those qualified for and aspiring to rabochiy positions. The position that the observed, long-term increase in the ratio of blue collar to white collar (average) wages reflects altered relative scarcities of high-ed and low-ed labor cannot be discarded on the grounds that increased supply of high-eds was not associated with decreased relative scarcity. Demand for high-eds presumably increased substantially, but the evidence indicates that supply increased considerably more rapidly. This despite a manpower planning system that attempts to keep demand and supply of specialists in continuous balance.
3. The broad wage and employment trends of this period are also consistent with an equalitarian "distributive model", in which money wages either play no important allocative roles or are so far from their equilibrium relationships that even substantial change is possible without allocative effect. In such an economy, there will be queues for entry into some employments and exit from others. Even substantial adjustment of the distribution of rents being earned (both positive and negative) can be made for distributive purposes without affecting the allocation of labor. In this model, the monopsonistic control of the state over wage structure is used to assure excess supply of labor to high priority sectors and occupations, with both quantitative and qualitative purposes in mind. (Excess supply permits "selectivity", a favored means of allocating quality among competing uses.) In this model, then, people queue within one branch or occupation for openings in other branches or occupations. As long as enterprises' demand for labor in different skills and occupations is not sensitive to relative wage rates, monopsonistic control over wage structure can be used to implement the center's priority ordering of branches in the manner described. When and if distributive policy dictates a change in the distribution of rents, this can be achieved by relative wage changes with little allocative effect, provided that the structure of the enterprise's table of organization is not sensitive to relative wages. In this model, then, there is wage elasticity on the supply side of labor markets but not on the demand side; the state's monopsony power is used not to locate an equilibrium structure of wage rates but to achieve a
pattern of excess supply (positive and negative) across branches, occupations, and skill grades that reflects the center's production priorities. As the relative supplies of labor in different occupations change (supply curves shifting with changes in income, educational attainment, urbanization, etc.), wage structure can be changed to reflect distributive objectives without excessively diminishing excess supply to high priority sectors. Therefore, what we may be observing in the marked change in the average wage relationships among rabochie, sluzhashchie, and ITR's is an adjustment of economic rents, which is of no allocative significance: Quantities demanded are largely unaffected because enterprise tables of organization are insensitive to wage structure; quantities supplied may be affected but not in any significant way because the disequilibrium structure of relative wages creates queues in a manner desired by those who design the wage structure.

The center is therefore free to pursue distributive goals such as the reduction of wage differential between occupational groups, especially differentials that are not of an equalizing or compensating sort. Thus, differentials intended to compensate for unfavorable climate or working conditions could be preserved or even augmented. Those, however, which are in the nature of economic rents, inherited from an earlier time and serving no intended allocative or distributive purpose, may be reduced or eliminated without undesired allocative effect. Special scrutiny might well be given to differentials unfavorable to the blue collar work force. Among these none would appear
more suspect than those associated with relatively favorable working conditions for which one qualifies by educational attainment, the cost of which has been almost entirely borne by the State.

4. Disaggregation by subperiods and by employment categories illuminates these alternatives. We refer in particular to the relationship between sluzhashchiy and ITR wage changes and to the temporal distribution of changes in the relationship between blue- and white-collar wage levels. (The latter aspect will be discussed in succeeding sections.)

The ratio of the average wage rate of sluzhashchiye, W(S), to that of ITR's, W(I), increased from .526 in 1950 to .685 in 1978. This rather substantial change in wage relatives is not easily reconciled with the competitive-relative scarcity model: On the supply side, it would appear that the educational expansion of the past several decades has increased the potential supply of office and administrative personnel at least as rapidly as it has the potential supply of engineering and technical personnel. (We refer to potential supply, i.e., the number of persons qualified for the class of white collar professions, rather than actual supply, since the latter cannot be observed. The relative scarcity argument is expressed in terms of changing numbers of persons educationally qualified for different positions, not in terms of the numbers of persons actually offering their services for different positions.) This is suggested by the apparently lower educational requirements of the major sluzhashchiy
occupations, by the major expansion of complete secondary education (more than half of all typists and secretaries had 10th grade educations according to the 1970 census\(^8\)), and by the particularly rapid growth of the category of SSUZ programs (ekonomika) which supplies personnel for upper level administrative positions. (Between 1950 and 1975, the number of SSUZ graduations in ekonomika increased by almost 700 per cent; graduations in "technical specialties", which excludes ekonomika, increased by 443 per cent. The extraordinary expansion of training is perhaps better illustrated by the increase in the share of ekonomika graduations in all SSUZ graduations: from 8.3 per cent in 1950 to 18.0 per cent in 1975.\(^9\) On the demand side, the picture is quite different: campaigns to reduce paperwork and administrative staffs in industry and very slow growth of sluzhashchiky employment—1.7 per cent p.a. vs. 8.1 per cent for total industrial employment, and 4.9 per cent p.a. for ITR employment. One must infer that the relatively slow growth of sluzhashchiky employment reflected demand conditions, not supply constraints; further it seems evident that the population of qualified persons expanded very rapidly during this period.

Comparing these demand, supply, and employment developments with those of ITR's, it seems evident that market conditions should have produced less upward pressure on W(S) than on W(I). Nevertheless, as we have seen, W(S) increased substantially relative to W(I). The cost-minimizing enterprise is being encouraged to economize on the category of labor which would appear to be increasing in relative
supply. Thus, whether produced by changing relative scarcities through market activity or by the central authorities in order to signal altered relative scarcities to employers, the change in the ratio $W(S)/W(I)$ seems quite inappropriate.

Furthermore, these wage movements seem inappropriate as a signal to young people who are choosing between educational programs leading to either služhashchiy or ITR positions. To these prospective students, who are making a discrete, one-time choice, it is the absolute difference between average wage levels, rather than the ratio of average wage levels, that is the relevant signal. (Rational investment in human capital would be strongly influenced by the expected difference between the present values of earning streams in alternative occupations. Current average earnings in different occupations presumably represent the most widely used evidence on the magnitudes of these differences.) The absolute difference, $W(I) - W(S)$, remained virtually unchanged, in real terms, between 1950 and 1978: In current rubles, the difference increased from 57.2 rubles to 65.7 rubles. The best Western estimate puts the growth in consumer goods prices in the U.S.S.R. between 1950 and 1975 at 8 per cent. This is understood to be a conservative estimate of consumer price change over this period and, of course, it does not extend to 1978, the omitted years being ones of evident inflationary pressure. Allowing for these aspects, the 15 per cent increase in the average wage difference in current rubles is virtually non-existent in real terms. Therefore, to the extent that prospective
earnings can be expected to influence professional choice, at this level of aggregation it does not appear that the wage system was used to signal students concerning relative scarcities in different occupational groups.

5. The distribution of wage and employment changes over time also poses problems for the allocative hypothesis. If the principal cause of the observed changes in wage structure is, as our primary hypothesis asserts, change in the relative scarcity of professional manpower, we would expect to find that periods of relatively large change in employment structure were also periods of relatively large change in relative wages. This is not the case. If the 1950-78 period is divided into five five-year periods and a concluding three-year period, we find that, for industry as a whole, periods of relatively large increases in the employment ratio, N(I)/N(R), tended, if anything, to be periods of relatively small increase in the wage ratio, W(R)/W(I).

In the construction sector, the rank ordering of the six periods by the magnitude of each of these changes is almost perfectly inverse: large increases in N(I)/N(R) are associated with small increases in W(R)/W(I).

If the large increases in N(I)/N(R) reflect larger increases in the supplies of qualified personnel, we would expect them to be accompanied by diminished growth of W(I) and relatively large increases in the wage ratio, W(R)/W(I). What we observe is more consistent with period-to-period variation in demand for white collar
personnel causing variation about a long-term, upward trend in \( W(R)/W(I) \), perhaps originating in distributive policy. In the succeeding sections we examine several developments during the 1950-78 period that bear on these alternatives.

6. When we examine the 1950-78 data from this perspective, one of the striking features is the surge in *sluzhashchiy* wages, \( W(S) \), during the 1960's. Between 1960 and 1970, \( W(S) \) increased at an annual average rate of 4.31 per cent. This may be compared with 1.41 per cent p.a. in the preceding decade and 3.12 per cent p.a. between 1970 and 1978. Perhaps more revealing is the relationship between growth rates of *sluzhashchiy* and *rabochiy* wages: Only during this decade does the former exceed the latter. In fact, during the 1950-60 decade, \( W(S) \) had grown at a rate little over half of \( W(R) \), 1.41 vs. 2.71 per cent p.a. The 1960-70 period apparently represents a substantial departure from the long-term trend, going back to the prewar period, of raising the ratio of *rabochiy* wages to those of *sluzhashchiya*: from 0.90 in 1940 to 1.23 in 1978. Is this exceptional episode understandable in terms of conventional labor market analysis? Apparently, it is, providing important support for the role of market forces in shaping Soviet wage structure.

Employment data show that the 1960-70 decade was one of extraordinarily rapid growth of white collar employment in industry. Employment of *ITR's* and *sluzhashchiye* combined grew at annual average
percentage rates of 3.4 per cent during 1950-60, 5.5 per cent during 1960-70, and 2.6 per cent during 1970-78. Only during the 1960-70 did the white collar growth rate exceed that of blue collars, and then by a substantial margin: 5.5 per cent p.a. vs. 3.3.

Looking at sluzhashchiye alone, the acceleration of employment growth is even more striking: From a per annum growth rate of 1.23 per cent in 1950-60, to 3.58 per cent in 1960-70, and then a sharp drop to -.04 per cent in 1970-78. (If 1959 and 1969 are used as the boundaries between the three periods, the acceleration of the 1960's is more striking. The growth rates of sluzhashchiy employment in the three periods then are 0.96 per cent in 1950-59, 4.27 per cent in 1959-69, and -0.34 per cent p.a. in 1970-78.)

Thus, the data for sluzhashchiye in industry as a whole show rising (relative) price and quantity over the 1960-70 period. In a market context this combination would suggest demand growth as the dominating market force. The available data on supply changes during this period do not indicate otherwise: From what we know of the supply side of this "market", it is difficult to infer any consequential change during the 1960-70 period in comparison with earlier and later years. That is, the number graduating each year from complete secondary school was substantially greater in 1960-70 than it had been in 1950-60, and substantially smaller than it was in 1970-78. The same goes for annual graduations from SSUZ and VUZ programs in ekonomika. Therefore, what little relevant evidence we
have does not indicate any distinctive developments on the supply side which could explain the enormous expansion of \textit{sluzhashchiy} employment in industry during the 1960's. (Note that between 1950 and 1978, the number of \textit{sluzhashchiye} employed in Soviet industry increased by 476,000. Between 1959 and 1969, the number employed increased by 449,000. Although shifts occurred in classification of slots between \textit{sluzhashchiy} and \textit{ITR} categories, the extraordinary growth of \textit{sluzhashchiy} positions in the 1960's cannot be explained this way. The relatively rapid growth of \textit{ITR} employment in the same decade is persuasive evidence of this.)

We thus are led to infer that the distinctive growth of \textit{sluzhashchiy} employment in Soviet industry in the 1960's originated in exogenous expansion of enterprise tables of organization, i.e., in an increase in demand. We know of no retreat during this period from the policy of denigrating paperwork and discouraging the growth of employment devoted to it. Nevertheless, the substantial expansion of the 1960's occurred, producing, apparently, the upward pressure on relative wages that the market model would lead us to anticipate. Indeed, if there is an aspect of this episode which might arouse the suspicion of market-oriented analysts it is the strength of the apparent wage effect. Given the enormous increases that had occurred in the stocks of suitably educated personnel, one might have anticipated highly elastic supply to \textit{sluzhashchiy} positions and less severe upward wage pressure.
Reviewing the 1950-78 period as a whole, we observe long-term trends toward relative increase in the supply of secondary school graduates and "high eds" who make up most sluzhashchiye; decrease in the ratio of sluzhashchiye to total industrial employment; and decrease in the ratio of average sluzhashchiy wages to blue collar wages. Given the general, demand-restricting policy of discouraging sluzhashchiy employment, the long-term decrease in the average wage of sluzhashchiye relative to that of rabochiye is consistent with the conventional market model. During the 1960's, for reasons that are not clear, sluzhashchiy employment grew relatively rapidly--more rapidly than blue-collar employment; supply of educationally qualified people continued to grow rapidly; and average sluzhashchiy wage rose relative to that of rabochiye. Inferring an exogenous increase in demand for sluzhashchiye from the sharp increase in number of slots, the temporary reversal of the downward pressure on the relative wages of sluzhashchiye is also as predicted by the conventional market model.

The long-term trend in the relationship between W(S) and W(R) can also be reconciled with a disequilibrium monopsonositic model serving a not unlikely distributive objective: raising the earnings of blue collar operatives relative to those of "paper shufflers". However, the substantial deviation from this trend in 1960-70 cannot be explained in this way. We would infer that, whatever the role of distributive policy in shaping the long-term shift in relative wages, demand-led market forces made themselves felt in the 1960-70 increase in the ratio of W(S) to W(R). What remains unclear is why the 1960-70
surge in demand for слуцашчыне should have had so strong a wage effect.

7. The ITR series also shows an interesting temporal pattern, beginning with the 1950-60 period. This period is unique in that ITR employment grows only very slightly more rapidly than does рабочий employment (4.63 vs. 4.27 per cent p.a.). Considering the rate of capital formation in industry during this period, the above average growth rate of the huge and ITR-intensive machine building branch, and the long-term policy of raising the ITR/рабочий ratio in industry, the failure of the number of ITR slots to grow substantially more rapidly than рабочий slots seems surprising.

If there are such things as markets for ITR's, one might expect them to have been quite tight during this period, with demand strong (for the reasons given) but inadequate supply, the latter limiting the expansion of ITR employment. The conventional market model would therefore lead us to expect significant upward pressure on ITR wage levels. This, evidently, did not occur. The average monthly wage of ITR's grew very slowly, both before and during the wage reform of 1956-60. (During 1950-55, the annual average rate of increase of W(I) was only 0.56 per cent p.a.; during 1950-60, the rate was 1.43 per cent p.a. These rates are very low not only in comparison with their later levels, but also in comparison with the rate at which blue-collar wages were rising.) At this level of
aggregation, it is not clear why the growth rate of blue collar wages should have been higher, and substantially higher, than that of ITR's during this period.

8. During the 1960-70 period, the growth rate of ITR employment accelerates, to 6.27 per cent p.a. for the decade. This is quite high in comparison with other periods and in comparison with the annual average growth rate of rabochiy employment (which was barely half as great, at 3.28 per cent p.a.).

Wage movements during this period were also distinctive. The annual average growth rate of rabochiy wages continues to exceed that of ITR's, but the ratio of the latter to the former is higher than in any other period. Indeed, the growth rates converge to such an extent that the absolute gap between W(I) and W(R) increases in current rubles: from 43.2 rubles per month in 1960 to 47.4 rubles per month in 1970. Over the 1950-78 period as a whole, the absolute difference between the average monthly wages of ITR's and rabochiy decreased from 52.1 to 32.3 rubles per month.

One might, as in the sluzhashchiy case, look to very strong demand for ITR's, inferred from the increase in the growth rate of ITR slots, as the explanation for the unusually high growth rate of W(I) during this period.

It is not really evident that an increase in the growth rate of W(I) from 4.63 per cent p.a. in 1950-60 to 6.27 per cent p.a. in 1960-70 should have such an effect on the growth rate of W(I).
We confront again the question of the degree of elasticity of supply which, in a market context, determines how much effect on price a given change in demand will have.

The best indicator that we have of this appears to be given by the relationship between changes in white collar employment and changes in the number of VUZ and SSUZ graduates (or "specialists") employed in industry. Our reasoning is as follows: When the number of specialists employed is increasing substantially more rapidly than the number of white collar slots, we may infer that employers are having no difficulty in locating suitable candidates for ITR and sluzhashchiye slots. (We combine ITR's and sluzhashchiye into a "white collar" category in this discussion because specialists are extensively employed in both of these job categories, and the published employment statistics do not indicate the nature of the slot occupied by the employed specialists. This means that our market indicator is flawed in that a more than negligible number of "specialists"—i.e., of VUZ and SSUZ diploma holders—are employed as rabochiy.) The difference between the incremental numbers of specialists employed and white-collar slots created indicates the extent to which the educational level of the white collar staff is being upgraded: If the difference is positive and large, "praktiki", occupants of ITR slots who lack the VUZ or SSUZ diploma which has come to be associated with their particular positions, are being extensively replaced (often by their own completion of a VUZ or SSUZ program) by diploma holders. This may be viewed as evidence of slack in white collar
markets: staffs are not growing fast enough to absorb newly hired specialists as net additions to the work force.

On the other hand, when the number of ITR slots created outpaces the addition of specialists, enterprises are presumably finding it more difficult to fill ITR slots with fully qualified people. In "internal" labor markets, training programs must be mounted at some cost and/or less than fully qualified personnel must be assigned to ITR jobs. In "external" labor markets, there will be competition among enterprises for qualified people, newly entering the job market or mobile from other enterprises. Upward pressure on white collar wage rates is likely, effectuated in part by upgrading of slots and by other measures made familiar under the heading of "wage drift". It is likely that his wage pressure will apply to both ITR's and sluzhashchiye. As the practice of reclassification of slots between these two categories indicates, there is substantial overlap of skills and responsibilities between them. This suggests significant substitution possibilities, which would, even in the short run, cause wage movements in the two categories to be related.

The 1960-70 period is distinguished by its very low ratio of incremental employment of specialists to incremental growth of white collar positions. During this decade, the number of specialists added exceeded the number of white collar slots added by only six per cent. When allowance is made for specialists, especially SSUZ graduates, taking rabochiy jobs and for both SSUZ and VUZ graduates

<table>
<thead>
<tr>
<th>Year period</th>
<th>White-collar personnel (thous.)</th>
<th>Specialists (thous.)</th>
<th>Approximate number of specialists (thous.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1950-55</td>
<td>412</td>
<td>n.a.</td>
<td>(600)</td>
</tr>
<tr>
<td>1955-60</td>
<td>422</td>
<td>930</td>
<td>(1,100)</td>
</tr>
<tr>
<td>1960-65</td>
<td>1,047</td>
<td>858</td>
<td>(1,400)</td>
</tr>
<tr>
<td>1965-70</td>
<td>1,010</td>
<td>1,321</td>
<td>(2,200)</td>
</tr>
<tr>
<td>1970-75</td>
<td>606</td>
<td>1,614</td>
<td>(2,800)</td>
</tr>
<tr>
<td>1975-77</td>
<td>334</td>
<td>831</td>
<td>(1,200)</td>
</tr>
</tbody>
</table>

Absolute increase in employment

White-collar workers = ITRs plus слуца́йные.

Specialists are graduates of specialized secondary and higher educational institutions (SSUZY and VUZY, respectively.


Line 3 - Based upon graduations in industry-related specialties in two or more years of each time period. Data are given by TsSU SSSR, Narodnoye obrazovaniye, nauka i kul'tura v SSSR (Public Education, Science, and Culture in the USSR), Moscow, 1977, pp. 178, 250; Narodnoye khozyaystvo SSSR v 1972 godu, p. 646;...v 1978 godu, p. 480.
taking "non-production" jobs at industrial enterprises (providing medical, educational, and other services not directly related to the production activity of the enterprise), one may infer a tight market for qualified white collar personnel. In both the preceding five-year period and the subsequent seven-year period, the incremental ratio (of specialists to white collar slots) is well over two-to-one. In 1960-70, it is very close to one and in 1960-70 we see distinctive upward pressure on the relative wage ratio of both ITR's and sluzhashchiye.

The thrust of this interpretation appears to be supported by relevant educational statistics. Data are published giving the number of VUZ and SSUZ graduations (separately) in approximately 20 different "groups of specialties". It is possible, albeit imprecisely, to distinguish those groups of programs which supply professional manpower to industrial ministries from those whose graduates would principally be headed for other sectors of the economy. (Because of the "non-productive" activities of industrial enterprises and the manufacturing activities of other sectors, this association will be approximate, at best.) These data permit us to estimate the absolute numbers of graduations in the "industrial" specialties during the time periods that we have been considering. They indicate that the ratio of accumulated graduations to additional white-collar slots created was especially low in 1960-70. Crude as this measure is, it lends support to the view of the 1960-70 period as distinctive for relative tightness of professional labor markets. This should alter our conception of the functioning of Soviet white collar labor markets.
9. The 1960-70 acceleration of white collar wage gains and position-creation is the most prominent feature of the temporal pattern of wage and employment developments in the 1950-78 period. In the cases of both sluzhashchichiye and ITR's, the wage acceleration was accompanied by acceleration of employment growth. There was also an apparent tightening of markets for specialists, as indicated by a distinct decrease, at the margin, in the ratio of specialists employed to white collar positions created. Which (if either) of these factors was the principal cause of the acceleration of white collar wage gains (relative to blue collar) is a question of some relevance to our study: If the former, support would be found for the conventional neoclassical model in which wages attach to skills rather than to slots, and "ITR" represents a skill category; i.e., it would be appropriate to think of markets for ITR's and sluzhashchichiye as such, in which accelerating demand could be expected to exert upward pressure on relative wage rates. If, instead, the relative wages of ITR's and sluzhashchichiye were responding not to strong demand for ITR's and sluzhashchichiye but to tight markets for specialists (the preferred, but by no means the only, occupants of ITR and sluzhashchichiye slots), support would be found for a "job competition" model: the terms ITR and sluzhashchichiye would apply, in the first instance, to positions rather than to skills; the rate of change in the number of such positions would be largely independent of the supply of credential-bearing specialists and would be a measure
of demand for the latter. Developments in markets for specialists would allocate specialists and influence white collar wage rates, but they would not determine the level of white collar employment. The number of ITR positions would be determined independently, without regard to wage structure; it would not, as in the neoclassical model, be a market outcome. Nor would the relative wage levels of ITR's and rabochiye be significantly a function of employment structure.

As indicated, the 1960-70 developments in industry do not permit us to distinguish empirically between these two interpretations because we have simultaneously accelerating ITR employment and apparent excess demand for specialists. The construction sector, however, offers a different combination of conditions in the 1960-70 period:

(a) declaration of the growth rate of ITR employment, from 9.5 per cent p.a. in 1950-60 to 7.8 per cent p.a. in 1960-70;
(b) rapid rise in the employment ratio, \( N(I)/N(R) \);
(c) tightening (by our indicator) of the market for construction specialists; the ratio of new white collar slots created to net increases in specialists employed was 0.93 in 1955-60, 1.21 in 1960-70, and 0.69 in 1970-77;
(d) rapid increase in the average ITR wage rate in construction: \( W(I) \) increased at annual average rates of 1.4 per cent in 1950-60, 3.8 per cent in 1960-70, and 0.67 per cent in 1970-78. \( W(R) \) continued to grow more rapidly than \( W(I) \) in 1960-70, but the difference between the rates shrank during this period.
These developments suggest the following points:

(a) The rapid rise in the employment ratio, $N(I)/N(R)$, is not associated with rapid increase in the wage ratio, $W(R)/W(I)$. A model in which increasing relative supply of ITR's, as an occupational category, is the dominant market force, does not apply.

(b) To the extent that demand is determining, the combination of slowdown in the growth rate of $N(I)$ and rapid increase in $W(I)$ indicates that it is not demand for ITR's per se that is at issue.

(c) Although the growth rate of $N(I)$ declined in 1960-70, its relationship to incremental employment of specialists indicates a shift to relative scarcity of the latter. This satisfactorily explains the marked increase in $W(I)$ in construction during this period.

In sum, the growth of ITR employment is not determined by the supply of specialists, but the behavior of ITR wages appears to be tied to the relative scarcity of specialists. It appears to be appropriate to speak of a market for specialists, but not of a market for ITR's: the former represent a scarce factor of production that is allocated by market processes; the latter does not. The notion that the decisive element in the long-term rise in the wage ratio, $W(R)/W(I)$, is the increased supply of ITR's and consequent increase in the employment ratio, $N(I)/N(R)$, appears to be erroneous. The
III. Disaggregation by Branch 1950-66

1. Employment and wage data, disaggregated by branch of the economy may shed additional light upon the allocative role of wage movements in the postwar Soviet economy. The data we refer to were published in the 1968 volume Trud v. SSSR (Labor in the U.S.S.R.)\(^1\), a rarely issued statistical compendium of the General Statistical Administration. Average annual employment levels (closely equivalent to man-years rather than to physical persons employed) and average monthly wage rates are given in the following detail: (a) by branch of industry (17 branches) plus construction and state-sector agriculture (state farms and "subsidiary agricultural enterprises"); (b) by occupational category: blue collar workers (rabochie) and ITR's; (wage but not disaggregated employment data are given for sluzhashchiye); (c) data in this detail are given for 1950, 1955, and each year in the period 1960-1966.

The branch disaggregation that Trud provides, it must be noted, is considerably less detailed than those employed by Western labor economists in similar inquiries. Our Soviet disaggregation offers many fewer branches. It also includes branches of very different sizes and homogeneity of activity, from the enormous and highly heterogeneous branch called "machine building and metal-working", which accounted for 28 per cent of total industrial employment in 1950, to the presumably more homogeneous "cement" branch, with 0.3 per cent of industrial employment in 1950.
2. The 1950-66 period is an appropriate span for our purposes: both employment and wage structures changed substantially in the directions which applied in the 1950-78 period as a whole. With respect to wage structure, the ratio of the average wage per rabochiy, \( W(R) \), to the average wage per ITR, \( W(I) \), changed as follows (over the period 1950-66): In industry as a whole, it increased from 0.57 to 0.70; in construction ("basic" constructions, as previously defined), it increased from 0.47 to 0.73; in State agriculture, the increase was more modest: from 0.43 in 1950 to 0.52 in 1966.

The number of ITR's, \( N(I) \), per 100 average annual blue collar workers, \( N(R) \), changed over the same period as follows: In industry and construction there were increases of 29 and 76 per cent, respectively. In State agriculture, this ratio decreased, presumably reflecting the large-scale conversion of collective into State farms (primarily in the period 1957-61). Because of the major structural changes in State agriculture that occurred during this period, developments in this sector bear a particularly weak relationship to the labor market phenomena we are exploring. Employment and wage changes in State agriculture will therefore receive little attention in the discussion that follows.
3. Employment and wage patterns at the start of the 1950-66 period may briefly be described as follows. The distribution of ITR's across branches was highly unequal. The number of ITR's per 100 rabochiye was much higher in industry (10.45) than it was in construction (6.79) or in State agriculture (4.12). Within industry, Light Industry (6.78), building materials (6.58), and the wood products group (6.66) had relatively few ITR's per 100 rabochiye; core branches of heavy industry had much higher ratios: electric power production (19.04), machine-building and metal-working (15.08), and chemical (precise figure not available) had the highest ratios in the set of branches for which we have data.

Inter-branch inequality in wage levels was less pronounced but followed a pattern similar to the one just observed. Heavy industry tended to have higher wage rates. State agriculture, construction, Group B (light industry and foods), building materials and the wood products group were relatively low wage sectors, for both blue collar workers and ITR's. As the last remark suggests, there was in 1950 very strong correlation across branches between W(R) and W(I): The simple Pearson correlation coefficient is 0.93 (with a t value of 10.7).
4. Before turning to the changes in wage and employment patterns over the 1950-66 period, we might consider the initial pattern in 1950 from the perspective of our underlying question: Are there any major features of the 1950 distributions which tend to support or to refute any of the alternative hypotheses we are considering concerning the role of market forces and the allocative role of wages?

One aspect that may attract attention is the very limited cross-sectional variation in wage structure, \( W(R)/W(I) \), especially in relation to variation in employment structure, \( N(I)/N(R) \). Because of the strong correlation between \( W(R) \) and \( W(I) \) across branches, variance in the wage ratio is quite small: the coefficient of variation \(^2\) of \( W(R)/W(I) \) is one-fourth of that of \( N(I)/N(R) \). This may cause doubts concerning the allocative role of relative wage levels (which has been questioned in the American economy, as we have indicated, in the work of Pine and Boeringer). Such doubts are encouraged by the absence of a statistically significant cross-sectional relationship between the magnitudes of the two ratios. That is, there is no evident tendency for those branches which pay (e.g.) relatively more to ITR's (relative to rabochiye) to employ relatively fewer of them. To be sure, reasoning such as this is not very persuasive. Inter-branch differences in production functions and elasticities of substitution cannot be ignored. One might note, however, that even within industry, groups that presumably have similar technologies (light industry, in particular, which is disaggregated into four branches), the expected direct relationship between \( N(I)/N(R) \) and \( W(R)/W(I) \) does not appear.
A second facet of the 1950 pattern is the identity of the low and high wage branches. In general, the pattern appears to conform to that found in the market economy of the U.S. in the same year. Referring to the wages of production workers, both economies show mining, metallurgy, machinery and chemicals as relatively well paid branches; wood products, food, and clothing industries have relatively low pay scales. The major divergence in branch orderings is in the placement of construction: relatively high in the U.S. (about 117 per cent of the average in manufacturing) but relatively low in the U.S.S.R. (about 82 per cent of the average in industry). This discrepancy may, in part, reflect the particular irregularity of construction employment in the U.S. (which is compensated for in the realized wage rate). But it also may reflect the particular role which the construction sector plays in the Soviet economy: it serves as a transitional occupation for large numbers of young people (especially males) on their way from agriculture to industry and other primarily urban activities.

Perhaps more persuasive evidence of the operation of market forces—especially of the role of productivity in determining relative wages—is provided by the available data on background characteristics of workers in different branches. Human capital theory predicts that wage rates will vary with education, experience, and other productivity enhancing characteristics. Soviet data for a more recent year, in which the ranking of branches by average wage level was virtually identical to that of 1950, bring this out.
The relatively low-wage branches have below average levels of education, experience, average age, or--a proxy for one or more of these variables--proportion of male workers. Thus, in the food industry in 1959, 54.4 per cent of all personnel had less than seven years of education, compared to 49.1 per cent in all of industry. In construction, the corresponding proportion was 54.3 per cent; in building materials it was 57.3 per cent; in logging, the largest component of the wood products group, it was 67.2 per cent; and on Sovkhozy, the predominant component of State agricultural employment, it was 75.6 per cent. Corresponding percentages in several relatively high wage branches:

- Chemicals: 45.0 per cent
- Machine building and metal working: 39.7 per cent

Coal and ferrous metallurgy, the two highest paid branches in our tabulation, had unimpressive educational attainment levels 53.4 and 53.3 per cent with less than seven years of education.

Some of the low wage branches are characterized by low average levels of experience as well, but several are not. Illustrative data are the following 1967 figures on the proportion of all workers and employees in the branch having less than five years of experience:

- All industry: 19.9 per cent
- Construction: 24.0
- Light industry: 25.0
- Food industry: 19.5
Correlated with average experience is average age in the branch. Again, construction and light industry are shown to have relatively young labor forces. Finally, two of the low paid branches—foods and light industry—are characterized by very high proportions of females. There is reason to believe that sex has an independent, and negative, effect on earnings—other background characteristics held constant.

This brief survey suggests that much, but certainly not all, of the pattern of inter-branch wage variation coincides with variation in background characteristics which have been shown to be relevant to earnings in market economies. In most cases, the work forces of low paid branches are characterized by distinctly low average age, low average experience, and/or high proportions of females.

5. As has already been indicated, 1950-66 saw a pronounced cycle in the demographic base of the labor force—the population in the able-bodied aged, Adaptation to this cycle affected the various sectors of the economy and branches of industry in quite different ways. For example, total agricultural employment followed a cycle with very similar shape, much greater amplitude, and turning points lagged 1-2 years. (Reference is to smoothed plottings of annual
percentage rates of change, all of which were negative in this sector after 1956). The construction series repeats this shape and shows similar amplitude (about 4-5 points between peak and trough). However, it never shows less than 3 per cent (positive) annual growth during this period and its turning points are lagged a further 2-3 years behind the agricultural employment series. The behavior of, and relationship between, these series appears to reflect a vital element in the overall adaptation to the demographic cycle, construction serving as intermediary between agriculture and urban non-agricultural manufacturing and service branches.

One presumably major and intended result of this pattern is the absence of such a cycle and much less year-to-year variability in the growth rate of total industrial employment. To be sure, there was substantial variation within and between branches of industry—contrast the machine building and metal-working series (consisting of two periods of almost perfectly stable growth rate, 1950-60 and 1961-66, at 5.3 and 6.5 per cent annual growth rates, respectively) with light industry (sharply declining, 1955-63, followed by sharp recovery). It therefore appears that analysis of rates of change for the 1950-66 period as a whole (in which only the end points of time series play a role) is not ruled out by strong cycles that would render such discussion of annual average rates of change meaningless. On the other hand, there clearly is sufficient periodicity to major underlying series to render advisable examination of developments in separate time periods. Fortunately, the years for which all of our wage and employment give data—1950, 1955, 1960, 1966—provide close correspondence to the turning points
of the underlying manpower supply series).

6. Within the sectors for which we have sufficiently disaggregated employment and wage data—industry and construction—major employment developments in the 1950-66 period may be summarized as follows. Total employment increased rapidly in both branches: at 3.9 per cent p.a. in industry and 5.1 per cent p.a. in construction. Employment of ITR's grew considerably more rapidly: by 5.7 per cent p.a. in industry and 8.6 per cent p.a. in construction. As a result, the number of ITR's per 100 rabochiye increased from 10.45 to 13.48 in industry and from 6.79 to 11.97 in construction. Outpacing this change in occupational structure was the growth of employment of professionals with advanced education: In industry, the number of SSUZ graduates employed increased at an annual average rate of 13.7 per cent between 1955 and 1966; in construction organizations, the rate over the same period was 16.9 per cent p.a. Both of these rates were substantially higher than that applying in the rest of the Soviet economy: 8.1 per cent p.a.\(^{11}\)

Employment of VUZ graduates in these sectors grew less rapidly, but considerably faster than did the number of ITR positions. Over the (full) 1950-66 period, the growth rate was 9.9 per cent p.a. in industry and 10.7 per cent p.a. in construction. In the rest of the economy, the corresponding rate was again 8.1 per cent p.a.\(^{12}\)

Between 75 and 90 per cent of these specialists, depending upon the sector and the year, were "engineers" (in the case of VUZ
II-58

graduates) or "technicians" (SSUZ graduates). That is, they had specialized, production-oriented training. The 1950-66 period, therefore, saw substantial change in the ratio of ITR to blue collar positions: up 29 per cent in industry and 76 per cent in construction. At the same time, very rapid upgrading of ITR staffs occurred as the numbers of formally trained "technicians" and "engineers" employed in industry and construction grew especially rapidly. Relating changes in these aspects during this interval with rates of change in the remainder of the 1950-78 period, it appears that the ITR/rabochiy ratio rose somewhat more rapidly during the latter period (1966-78), but that the rate of growth of "specialist" employment, and the rate of upgrading of the ITR work force, went at a considerably faster pace during the first part of the period (1950-1966).

Our conclusion is that if we are interested in the relationship, if any, between changes in the proportions of ITR's in the work force and in the supply of diploma holders, on the one hand, and changes in the relative wage rates of ITR's and rabochye on the other, the 1950-66 period shows sufficient change on the employment side to make it suitable for study.

7. Facilitating investigation of these relationships is substantial inter-branch variation in employment patterns over the 1950-66 period. In terms of major sectors, employment growth may be characterized as follows: Total employment grew especially rapidly (relative to the rate for industry as a whole) in most of heavy industry and in construction. Within heavy industry, fuel production and metallurgy (represented in our data by coal mining and ferrous metallurgy,
respectively) grew relatively slowly; rapidly expanding were the electric power, chemicals, machine building and metal-working, and building materials branches. Major sectors whose total employment was growing much more slowly were the wood products group (Logging, woodworking, paper and cellulose), the foods group, and light industry (textiles, clothing, and shoes). Within product groups, there are relatively small branches whose growth rate differs markedly from that of the group as a whole (meat products in the foods group, for example), but the following generalization is useful: Fast growing: Heavy industry minus fuels and metals; slowly growing: Group B plus wood products.

This pattern of growth rates applied, with very few exceptions, to employment of both rabochiye and ITR's. That is, for this period as a whole, branch growth rates of $N(I)$ and $N(R)$ are strongly correlated. (The simple Pearson correlation coefficient is 0.62 for the 20 branches for which we have data, with a t value of 3.35.) However, it is also important to note (a) that the growth rate of $N(I)$ exceeded that of $N(R)$ in most branches and (b) that the variance of $N(I)$ growth rates is somewhat greater than that of $N(R)$ growth rates. This means that, in general, in those branches in which the growth rate of $N(R)$ is relatively high (low), that of $N(I)$ is relatively higher (lower). Since the branches in which both growth rates were relatively high tended to be branches in which $N(I)/N(R)$ was high initially (i.e., in 1950), employment growth patterns for the period tended substantially to increase the inter-branch inequality of $N(I)/N(R)$ ratios.
To summarize the branch employment changes over the 1950-66 period: Both \( N(R) \) and \( N(I) \) increased in all branches; growth rates were strongly correlated and were distinctly low in foods, light industry, wood products, fuels and metals. \( N(I) \) grew more rapidly than \( N(R) \) in almost all branches, inter-branch inequality of \( N(I)/N(R) \) increasing in the process.

8. These diverse employment patterns, and the wage changes that accompany them, shed light upon the allocative role of Soviet wages. If there is a behavioral relationship between the changing relative scarcity of professional (i.e., engineering and technical) manpower and its (relative average) wage, we would expect this relationship to appear in disaggregated branch data. And if there is such a relationship, it presumably originates in "economizing" behavior analogous to that implicit in the neoclassical model. Concerning the response of employers to change in relative wage rates, we anticipate that pure substitution effects would dominate whatever response there is. The nature of output planning leads us to doubt that there will be either significant scale effects (i.e., that change in the relative prices of different grades of labor will significantly affect output plans and thence the demand for different grades of labor) or price effects (i.e., effects of labor cost changes on product price, thence upon output rates and the demand for different grades of labor).
9. When we turn to wage developments at the branch level for the 1950-66 period, we find that in all 20 of the branches for which we have data, the average wage rate of rabochiye, $W(R)$, rose relative to that of ITR's, $W(I)$. The differences in growth rates, $W(R) - W(I)$, range from 10.3 per cent in the chemical branch to almost 70 percentage points in construction. Therefore, the ratio of wage rates $W(R)/W(I)$, the relevant signal for employers optimizing with respect to employment structure, increased in every branch, i.e., ITR's were becoming less costly relative to blue collar workers in every branch.

If, in every branch, the only important factor in these changes was sharply increased supply of professionals relative to blue collars, our neoclassical model would predict more extensive employment of professional relative to blue collar labor—i.e., a rising $N(I)/N(R)$ ratio in every branch. This is not the case: the employment ratio, $N(I)/N(R)$, decreased in several branches (in State agriculture, in three branches of light industry, and in one branch of the food group) and was unchanged in another (the large residual branch, "foods other than sugar, meat, and fish"). Evidently the very simple hypothesis we have proposed does not satisfactorily cope with changing wage and employment relationships at the branch level.
10. What additional elements may be involved can be explored by closer examination of changes in these relationships. We observe the following: (a) Some evidence of a positive (cross-sectional) relationship between the magnitudes of changes in \( \frac{N(I)}{N(R)} \) and \( \frac{W(R)}{W(I)} \). The simple Pearson correlation coefficient (on unweighted percentage changes in the two ratios) is +0.34. The \( t \) value, with 17 degrees of freedom, is 1.49, which would be significant at the .20 level. Spearman's rank order correlation coefficient is +0.30. The \( Z \) value is 1.27, significant at the .20 level.

This may seem to be consistent with our neoclassical model—larger changes in relative prices being associated with large changes in factor proportions. But this relationship, which is not unqualified even within a given production function, will hold across production functions only if (i) scale and price effects on factor proportions can be safely ignored (which we have assumed), and (ii) there are not substantial inter-branch differences in the elasticity of substitution between grades of labor. We have no information on the latter aspect and must, accordingly, remain skeptical about the correlations referred to. (b) Although we are not in a position to disentangle the several elements referred to above, we can speculate as follows. Demand for ITR's during this period appears to have been increasing most rapidly in heavy industry: the pace of capital investment was high here as was, presumably, the rate of technological progress; the rate of growth of blue collar employment was highest in this area, and, since a main
function of ITR's is supervision, this too would affect the demand for ITR's. As indicated, technical change was presumably "ITR-using", meaning that it tended to raise the marginal productivity of ITR's relative to that of other grades of labor. Therefore, the pace of output growth of most of these branches combined with what appears to be a reasonable surmise on the nature and branch distribution of technical change suggest that in these branches, increases in the employment of ITR's should be high relative to changes in the (relative) wage of ITR's.

When we examine the branch pattern of changes in the two ratios, we find some confirming evidence: In machine building and metal working, electric power, building materials, and construction we find relative small increases in $W(I)$ associated with relative large increases in $N(I)$; in light industry and the largest food branch, there were relatively large increases in $W(I)$ and small increases in $N(I)$. There are, however, numerous exceptions to this generalization. Again, we cannot have much confidence in it.

(c) If we construct a 3 x 3 contingency table in which changes in each of the two ratios are classified as low (including negative), medium, and high, and place each branch in one of the 9 cells, the only patterns that emerge are the following:

(i) Most of heavy industry (machine building, coal, electric power, ferrous metallurgy) is in the column for low increases in the wage ratio, $W(R)/W(I)$; (ii) none of Group A is in the row for low increases in the employment ratio, $N(I)/N(R)$; (iii) Most of Group B was in the row for low $N(I)/N(R)$ increase, but with considerable scatter over the wage change columns. In other words, light industry
tended strongly to have low increases in the number of ITR's employed per rabochiy, but with no apparent relationship to change in relative wages. Heavy industry (but not all of Group A) tended to have small gains in W(R) relative to W(I), with average or higher increases in the relative employment of ITR's. Group A branches (including the wood products branches and building materials) plus construction were scattered over all three wage change columns but do not appear in the "low N(I)/N(R) increase" row. In short, each of the two major groups of branches shows "system" with respect to change in one of the ratios but not with respect to the other.

These patterns suggest that the distribution of branches over the nine cells of our matrix is not entirely random; there is an important systematic component. Second, the systematic component seems primarily to relate not to the relationship between the magnitudes of changes in factor proportions and relative wages but to the sector of the economy to which the branches belong. Third, the systematic effect of sector seems to relate to one ratio or the other, but not distinctly to the relationship between them. (Group B is largely in one column, but dispersed over rows; Group A does not appear in one row, but is scattered over columns; the core branches of heavy industry are concentrated in one column, but appear in two of the rows.) This suggests that distinct wage and employment policies are being pursued with respect to recognizable groupings of branches; that the wage policy has some systematic effect upon the W(R)/W(I), but that this ratio, per se, plays no important allocative role. This view is supported by the very strong cross-sectional correlation between rates of change of
blue collar and ITR wage levels and by the almost equally strong correlation between rates of change of blue collar and ITR employment.

II. In this interpretation, the observed changes in the wage and employment ratios are incidental to more substantial and significant changes in the inter-branch wage structure and distribution of manpower. In the branches whose share of total employment was being increased (almost all from Group A), their shares of total ITR employment increased especially rapidly. This presumably reflects technological change and qualitative aspects of the development program under which these branches (electric power, chemicals, machinery, etc.) were favored. In those branches (mostly from Group B) whose overall wage level was being raised relative to industry as a whole, the wages of rabochiye increased especially rapidly. This combination of circumstances produces the branch patterns of changes in the employment ratio, \( N(I)/N(R) \), the wage ratio, \( W(R)/W(I) \), and the (weak and apparently insignificant) positive relationship between changes in them.

Can these branch patterns of employment and wage changes be satisfactorially explained in terms of our neoclassical model? Not very easily, it would appear. (i) In much of heavy industry we see rapid employment growth (electric power, chemicals, cement, machinery) and relatively slow wage growth. In a neoclassical context, this would suggest strong supply relative to demand, (ii) In Group B and wood products we see slow employment growth and rapid increase in relative wage level. This suggests strong demand relative to supply,
Both of these inferences seem difficult to defend. Consider first the market for blue collar workers. All branches relied overwhelmingly upon on-the-job training for the production of skilled workers. Branch specialization, therefore, was presumably not very great. To the extent that background characteristics were related to prospects for skill acquisition, it appears that Group B and wood products would have made lesser demands on their prospective employees. Especially during a period of rapid influx from agriculture of young people with limited education, it would seem that supply to branches characterized by youth and/or low educational attainment would be rising relatively rapidly. Comparing also planned growth rates of capital investment and output, it is not likely that Group B (plus wood products) would be the sector in which tight blue collar labor markets would be pushing wages up at an above average pace.

Looking separately at the ITR markets, Group B (and wood products) again does not appear to be the area of particular demand pressures. The manpower planning literature stresses the role of blue collar employment in projecting demand for ITR's. This, of course, would mean relatively weak demand in Group B and strong demand in most of Group A. In addition, the literature indicates that the latter sector was the main locus of ITR-intensive technical change.

On the supply side, the only data we have to go on are graduations in relevant specialties, in relation to the size of the ITR stock. Graduations in the specialties of energy, metallurgy,
machine building and instrument making, and electronics we will associate with the heavy industry component of Group A. Graduations in food and consumers' goods specialties we associate with Group B. Over the 1950-65 period, graduations at the VUZ and SSUZ levels combined in the two groups of specialties increased at about the same rate: 3.5 per cent p.a. in the Group A specialties and 3.3 per cent p.a. in the Group B specialties. In absolute terms, the Group A growth rate was much higher: the number of annual graduations increasing by 169,000, compared to 31,000 in Group B.

Perhaps the best measure at our disposal of the changing relative scarcities of professionals in these two areas is the ratio of graduates to the level of employment of ITR's. If attrition rates in the two sectors are similar, this ratio indicates the degree to which graduations meet replacement needs and, perhaps, contribute to upgrading of staff. Throughout the 1950-65 period, this ratio (of specialists produced to "stock" of ITR's employed) was substantially higher in the Group A specialties (branches) than in the Group B specialties (branches): 9.7 per hundred in 1950 vs. 4.8 per hundred in 1950; 13.5 per hundred in Group A in 1965 vs. 9.2 per hundred in the Group B specialties (branches). The relevant interpretation would appear to be that the relative scarcity of specialists for Group A was less throughout the period, but that the change (reduction) in relative scarcity of specialists was greater in Group B. That is, in Group B there was more rapid increase in the availability of specialists relative to replacement needs. In this sense, and considering only the replacement component of demand,
it appears that a greater "loosening" of the market for ITR's was occurring in Group B than in Group A.

12. We would draw the following inferences from the foregoing:
(a) The observed pattern of wage and employment changes at the branch level is not satisfactorily explained by a neoclassical model in which variation in supply of presumably specialized ITR's is the decisive market influence. (b) To the extent that sectoral employment and wage policies are at work--policies that are not constrained by labor market conditions--the Group A (producers' goods) vs. Group B (consumers' goods) dichotomy does not provide a fully satisfactory basis for distinguishing the affected branches. That is, the dichotomy tells little about the ranking of branches either by growth rate of employment or by growth rate of average wages.

An alternative approach to the relationship between wage and employment changes over this period emphasizes inter-branch differences in demand. Assume a high degree of substitutability of workers in each employment category across the branches included in our survey. (Considering the limited sectoral coverage of our data and the high degree of mobility of both rabochie and ITR's among branches--as reported by turnover data--this is not an unreasonable assumption.) Inter-branch differences in supply cease to play a role, and differences in demand become decisive. In a dynamic setting, rapidly expanding branches bid labor away from other branches in which it could readily be employed. It is,
of course, not required that every rabochiy and ITR be equally capable of (or desirous of) employment in every branch for this to produce a significant, direct relationship between rate of growth of employment and rate of wage increase. 14

As the preceding section would suggest, this hypothesis finds no confirmation in the data we are considering. Correlation between rates of change of employment and of wage level yields nothing. The Spearman rank order correlation coefficients are -0.04 and -0.09 in the ITR and rabochiy cases, respectively. Needless to say, neither coefficient approaches statistical significance. The same is true of Pearson product moment correlation coefficients (on the magnitudes of percentage of changes in wages and employment for each labor force category).

13. We have explored several market-oriented approaches to inter-branch wage changes between 1950 and 1966. The results varied but in no case were they strongly persuasive.

The alternative we have suggested to these allocative interpretations of the observed changes in wage structure is a distributive hypothesis. As we have already indicated, the well known and long-standing Soviet policy of reducing income differences between "social groups"—"mental" and "physical" workers included—provides an alternative explanation of the major shift in relative wages we are discussing: the long-term decrease in \( W(I) \) relative to \( W(R) \). Support for an important distributive role appears at a number of points: In the continuity of the wage shift, notwithstanding
important changes over time in the relative supply of specialists; also in the fact that the wage shift occurred in all branches, including those in which the employment ratio shifted toward decreased relative employment of ITR's.

If the policy of reducing earnings inequalities extended to inter-branch differences as well, this should be reflected in our data in the form of negative correlation between the level of wages in the initial year of the period (1950) and the (percentage) rate of increase in wages (of each class of labor) over time. Such correlation is indeed shown by the data; Among rabochiye, the Pearson product moment correlation coefficient (between 1950 average wage and percentage increase in average wage, 1950-66) is -0.45, which is significant at the .05 level. The Spearman rank order correlation coefficient is -0.52 which is also significant at the .05 level. (Both calculations were made for our full set of 20 branch observations.)

Among ITR's, the evidence points in the same direction but is statistically weaker. Both correlation coefficients have the right (negative) sign, but the product moment coefficient (of -0.25) has a t value of only 1.09, significant at the .30 level. The rank order correlation coefficient is -0.44, significant at the .10 level.

This relationship (between initial levels and percentage changes) was not sufficiently strong to prevent increase in the variance of wage rates, across branches, of either rabochiye or ITR's. Coefficients of variation remained very much as they had been, however: that of rabochiye decreased from .309 to .282, that of
ITR wages increased from .271 to .307. If an equalitarian distributive purpose was involved, its effect was to limit the growth of inequality during a period of substantial increase in money wage rates, rather than actually to reduce inter-branch inequality.

Within branch inequality, as measured by the absolute difference $W(I) - W(R)$, decreased in most branches. The direction of change in the difference and its size at the end of the period (1966) do not appear to be related to the growth rate of ITR employment in the branch. In five of the 9 branches with distinctly high $N(I)$ growth rates, the difference in wage rates was relatively large; in the other four it was not. Therefore, if rapid growth of $N(I)$ is an indicator of strong demand (rather than supply), the absolute wage difference, $W(I) - W(R)$, was not obviously being used as a signal for the acquisition of relevant skills and credentials. Wage and employment data for the period as a whole (1950-66) therefore appear to provide clearer evidence of distributive than of allocative function. This applies to both inter-branch and inter-category wage structure. This inference finds interesting support within the low wage (level), low (employment) growth sectors: wood products, food, and light industry. In the latter two sectors, reductions in the wage difference, $W(I) - W(R)$, were small or negligible (not exceeding 16 per cent in any of the branches). In all three branches of the wood products group, the absolute reductions in $W(I) - W(R)$ were substantial (25 to 54 per cent). This sector is distinguished from the other low-wage, low growth sectors in only one discernible way: In 1950, its ITR's were less poorly paid in comparison with the all-industry average. This was associated with
very low percentage increase in $W(I)$, 1950-66, and the greatest reductions in $W(I) - W(R)$. (In timber and woodworking, the smallest differences in the entire distribution were attained.) This is more easily reconciled with (horizontal) distributive considerations than it is with an allocative function, given what we know of relevant labor market conditions.
IV. Disaggregation by Period, 1950-1966

In the preceding section, wage and employment changes at the branch level were considered over the 1950-66 period as a whole. In effect, only beginning and end year conditions were considered. This long-term perspective provided clearer evidence of distributive than of allocative influence upon cross-sectional wage changes. In this section, we explore the possibility that allocative effects have been obscured by neglect of changes in labor market conditions within the period. As previously noted, the years 1950-66 comprise three subperiods which are quite distinctive in this regard. In particular, we noted a strong cycle in underlying manpower supply and associated swings in flows through the educational system and in labor supply to different sectors of the economy. To the extent that these swings impacted upon the branches and labor force categories included in our data, any role that the wage system may have played in accommodating to these swings should be revealed in wage and employment data for appropriately determined periods. The published data constrain us to the three periods 1950-55, 1955-60, and 1960-66. Fortunately, the 1955 and 1960 boundary years coincide closely (although not perfectly) with the upper and lower turning points, respectively, of the cycle in the able-bodied population. Thus, we have three periods to work with, each distinctive in terms of underlying manpower dynamics and each long enough for those differentiating conditions to make themselves felt.
Table 4 - Wage levels, 1950, and percentage rates of change, 1950-1966, by branch of industry.

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<td>All Industry</td>
<td>W(R) 120.8</td>
<td>W(I) 10.9</td>
<td>W(R) 17.8</td>
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<td>W(R) 18.1</td>
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<td>W(I) 3.6</td>
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<td>W(R) 18.1</td>
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<td>W(R) 18.1</td>
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W(R) = Average monthly wage rate of rabochiy.
W(I) = Average monthly wage rate of ITRs.

Source: TsSU SSSR, Trud v SSSR (Labor in the USSR), Moscow, 1968, pp. 140-145.
Table 5. Employment levels, 1950, and percentage rates of change, 1950-66, by branch of industry.

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T.E. = Total employment; n.a. = not available
N(R) = Employment of rabocheye; N(I) = Employment of ITRs. All employment dates are annual averages (full-time equivalents).

Source: TsSu SSSR, Trud v SSSR (Labor in the USSR), Moscow, 1968, pp. 86-89, 121, 126.
A. 1950-1955

1. During this period, aggregate manpower supply (as measured by the size of the population in the able-bodied ages) was increasing fairly rapidly, as were employment of blue collar workers, \( N(R) \), and of ITR's, \( N(I) \). With respect to profesional manpower, we have data only on the employment of VUZ graduates in construction and in industry as a whole. In both of these sectors, the number of VUZ graduates employed grew at rates (8.3 per cent p.a. in industry and 7.7 per cent p.a. in construction) slightly below those applying to the period since 1950 as a whole. Overall, in comparison with subsequent periods, this appears to have been a period of relatively ample (and increasing) labor supply.

2. Cross-sectional changes in blue collar employment, \( N(R) \), and wage levels, \( W(R) \), during this period are especially interesting. On one hand, there is some evidence of an inverse relationship between branch growth rates of \( N(R) \) and \( W(R) \): Those branches in which employment of rabochiye was growing relatively rapidly tended to have below average (percentage) increases in blue collar wage level. On the other hand, there is also a strong inverse relationship between branch level of blue collar wages in the initial year of the period and (percentage) rate of wage increase during the period: the higher the branch's \( W(R) \) figure for 1950, the smaller the percentage increase, 1950-1955. (For convenience, the following notation will be used below: dots will be used to indicate percentage growth ratio--\( N(R) \), \( W(I) \), etc.)
and base year levels will be shown with numerals—W(R)50 for the average wage in 1950, etc.)

In a market context, the first relationship—the inverse one between N(R) and W(R), 1950-55—would point to interbranch variation in the pace of supply increase (i.e., of rightward shift of labor supply curves) as the major explanatory factor. Given the specific branch developments of this period, this would mean that supply of blue collar labor to core branches of heavy industry (electric power, chemicals, machinery) was increasing more rapidly than it was to Group B and the wood products branches. This is not inconceivable. However, there is little support for this in relevant manpower supply data. Throughout this period—in contrast with the rest of the 1950-66 period—graduations from incomplete secondary school were absolutely and relatively very much greater than graduations from complete secondary school. In addition, stability of agricultural employment during the period suggests that substantial shifts of manpower to the non-agricultural branches—which were to accelerate markedly in subsequent years—were already underway. Given the higher educational and skill requirements of the core branches of heavy industry listed above, there is reason to be uncomfortable with the notion that the combination of relatively fast growth of N(R) and slow growth of W(R) in these branches is the product of a shift in supply of blue collar labor in favor of these branches.

Perhaps more persuasive is the second relationship referred to: the strong negative correlation between W(R)50 and W(R), 1950-55, across branches. This relationship suggests a distributive policy
at work: low wage branches tending clearly to enjoy larger relative increases in wage level. The presence of the two relationships reflects the circumstance that several of the faster growing branches (high $\dot{N}(R)$) are also (initially) high wage branches. Therefore, any variable, such as $\dot{W}(R)$, that is (negatively) correlated with one will tend to be (negatively) correlated with the other. As to which correlation tells more about the true cause of the distinctive wage movements of this period, one may be influenced by the following:

(i) The second of the statistical relationships referred to appears to be the stronger. The $\dot{N}(R), \dot{W}(R)$ relationship shows a Pearson product moment correlation coefficient of $-0.34$ with a t value of $-1.49$ (17 df), which is significant at slightly less than the .20 probability level. The $W(R)50, \dot{W}(R)$ relationship shows a Spearman rank order correlation coefficient of $-0.52$ with a z value of $-2.25$, which is significant at the .025 probability level.

(ii) Developments in the light industry group may also be informative. This is, in general, a low-skill sector, with relatively old and simple technology and a relatively young, poorly educated and poorly paid labor force. During this particular five-year period, blue collar employment in this sector (especially in two of its larger branches) grew relatively rapidly: at 5.5 per cent p.a., compared with 4.9 per cent p.a. in industry as a whole. If wage structure were responding primarily to differences in relative supply, this would appear to be a clear case in which to anticipate downward pressure on relative wage levels. Instead, the average wage level of the sector increased slightly more rapidly than the average
blue collar wage in all of industry (2.2 vs. 2.1 per cent p.a.). Furthermore, if we look inside the sector we see a clear tendency for \( \dot{W}(R) \) by branch to vary inversely with \( W(R) \). There is no inverse relationship between \( \dot{N}(R) \) and \( \dot{W}(R) \).

(iii) Finally, it should be observed that this was a period of relatively high inter-branch variation in \( \dot{W}(R) \) and low variation of \( \dot{N}(R) \). The coefficient of variation of \( \dot{W}(R) \) for the five-year period was .60, compared to .36 for 1955-60 and .33 for 1960-66. The corresponding coefficients of variation for \( \dot{N}(R) \) were .47, .93, and .79, respectively. Thus, we have in 1950-55 a period distinctive for its relatively small changes in the branch distribution of blue collar employment and its relatively large changes in the branch structure of blue collar wages. If wage structure plays a role in the interbranch allocation of rabochiye, this is not the period in which that role is evident.

We would infer from the foregoing that changes in the branch structure of blue collar wages during this particular period were dominated by distributive rather than allocative goals. We would also note the following combination of labor market developments during the period: relatively rapid increase in both aggregate labor supply in the economy and employment in industry; relatively slow increase in the average blue collar wage level in industry as a whole (2.1 per cent p.a., compared to 2.9 per cent p.a. in the rest of the 1950-66 period); and relatively small change in the branch structure of blue collar employment. These conditions may bear upon the extent of the allocative role of wage structure in the Soviet economy.
3. Among ITR's, wage-employment relationships were quite different. Here, there was a very strong, positive relationship between growth rates of employment and wages, \( N(I) \) and \( W(I) \). The Pearson product moment coefficient is +0.57 with a t value of 2.78 (16 df), which is significant at the .01 level. In a market setting, this combination suggests an allocative role for relative wages under conditions of strong, but variable demand. On the other hand, correlation of wage changes with level at the start of period is negligible: the rank order correlation coefficient on \( W(I) \) and \( W(I)_{50} \) is +0.12 with a z value of +0.53. These results support a distinct allocative, rather than distributive, role for changes in the structure of ITR wages during this period.

The economic basis for this may be the following: During 1950-55, blue collar employment in industry was growing rapidly. This overall growth combined with relatively faster growth in the "progressive," ITR-intensive branches of Group A generated strong demand for ITR's. Supply side developments were less expansive: the graduation of engineers and technicians in industrial specialties was much lower during this period than in the rest of the period, both absolutely and relative to the growth of ITR staffs in industry, as can be seen from the following data (in thousands of persons): 4
These numbers suggest that during 1950-55, with allowance for attrition from ITR staffs, total graduations were in approximate equality with gross hiring of ITR's in industry. However, if we allow also for the substantial number of these graduates who did not take jobs as ITR's in industrial production activity (going into research, administration, blue collar work, etc., in industry or other sectors), it appears that ITR ranks were filled out with substantial numbers of praktiki. This tightness in the market for specialists may have been associated with use of the wage system to maintain the relatively rapid growth of ITR employment in the priority branches of Group A.

4. These developments in the blue collar and ITR markets illuminate the change in the wage ratio, W(R)/W(I), during this period. We might have anticipated that the apparent tightness in the market for specialists, the apparent slack in blue collar labor markets, and the extraordinarily small increase in the employment ratio, N(I)/N(R), would be associated with downward movement in the wage ratio, W(R)/W(I). Instead, this ratio rises—not very rapidly in relation to the rate of change over the entire 1950-78 period (1.17 per cent p.a., 1950-55 vs.
1.42 per cent p.a., 1950-78)--but it rises nevertheless. This, we would associate with distributive objectives—closing the wage gap between mental and physical workers—tempered by a distinct pattern of relative scarcities in the markets for these broad categories of labor.

B. 1955-1960

1. Aggregate labor supply decelerated rapidly during this period, absolute increments to the population in the able-bodied ages declining from 2.6 million in 1955 (the peak actually was reached in 1954) to minute 150,000 in 1950. Transfers from agriculture (especially from the kolkhoz sector) accelerated, the kolkhoz labor force decreasing by an estimated 3.5 million persons. Much of this flow went into construction (whence it would later move to manufacturing and the services), which experienced an extraordinary increase in total (annual average) employment of 2 million man years in basic construction activity. This represented an annual growth rate of 10.1 per cent, compared to 4.1 per cent p.a. for the entire 1950-78 period.

In industry, the growth rates of both blue collar and ITR employment declined relative to the preceding period. N(I) continued to exceed N(R) by only a small margin, as in the previous period. The employment ratio, N(I)/N(R), rose by 1.9 per cent over the five-year period, compared to a 1.5 per cent increase in 1950-55. Insofar as we can judge by data for VUZ graduates alone, the market for specialists eased considerably. The extent of this change is best seen
from incremental employment figures: the ratio of the change (increase) in the number of VUZ graduates employed in industry to the change (increase) in the number of ITR's employed increased from 0.24 in 1950-55 to 0.66 in 1955-60. The data on specialists graduated and ITR's employed, given in the preceding section, also show an enormous increase in the ratio of the former to the latter in the second of these five-year periods. Evidently, labor market conditions in this period contrast quite markedly with those of the preceding period in ways which, in a market context, could be expected to make themselves felt in the structure of wages.

Concerning wages, we will note at this point only that 1955-60 saw a substantial acceleration in the growth of average blue-collar wages (from 2.1 to 3.3 per cent p.a.) and a no more than negligible acceleration in the growth rate of ITR wages (from 0.90 to 1.02 per cent p.a.). This produced a sharp rise in the wage ratio, W(R)/W(I), the sharpest rise in any of the six subperiods into which we have divided the 1950-78 period. The annual average rate of change in this ratio in 1955-60 was 2.29 per cent, compared to 1.42 per cent for the period as a whole.

Evidently, this was a period of distinctive labor market conditions and clear changes in employment and wage relationships. As such, it may be crucial for our understanding of the manpower processes that we are exploring.
2. With the deceleration of blue collar employment in industry, the variance of branch growth rates increases substantially. (The standard deviation of unweighted branch N(R) figures rises from 12.70 in 1950-55 to 20.35 in 1955-60.) This reflects the very uneven allocation of the deceleration across branches: The biggest decreases occurred in light industry, foods (excluding sugar, meat, and fish, which together accounted for 26.7 of total food industry employment in 1955, and which experienced acceleration of N(R) growth in 1955-60), and the wood products group. Substantial decelerations also occurred in several branches of Group A (other than wood products), including coal and chemicals. However, relative to growth rates of N(R) in the previous period, the decelerations were greatest in wood products (from a 17 per cent increase over 1950-66 to a 4.5 per cent increase, 1955-60), in light industry as a whole (from 30.9 per cent to 19 per cent), and in foods other than sugar, meat, and fish (from 20.3 per cent to 8.8 per cent).

The rapid increase in blue collar wages was allocated very differently. W(R) increases were very low or negative in wood products (negative), in light industry, and in foods (other than sugar, meat, and fish). Only two other branches in Group A had increases in W(R) which were in the same low range as encountered in this group. Since light industry, foods, and wood products were still the low wage sectors at the beginning of this period (1755), it is evident that the redistributive effect observed in 1950-55 disappeared. Indeed, Spearman's rank order correlation coefficient measuring the strength of the relationship between W(R), 1955-60 and the branch-wage level
in 1955, \( W(R)_{55} \), drops to -0.01 (compared to -0.52 in the preceding five-year period).

In contrast, the Pearson correlation coefficient for the relationship between \( N(R) \) and \( W(R) \) during the five-year period is +0.27 with a t value of 1.16 (17 df). Although this value of t would be considered statistically significant only at a significance level of almost .30, we may be impressed by the clear shift, including change of sign, of the correlation coefficient from the preceding period.

As explained previously, a direct relationship between \( W(R) \) and \( N(R) \) in a dynamic market setting suggests tightening labor markets in which inter-branch variation in \( W(R) \) primarily reflects inter-branch variation in growth of demand for labor: Branches in which demand is growing relatively rapidly push wages up more rapidly as they increase their shares of a grade of labor that is largely substitutable between branches; this produces the direct relationship between \( N(R) \) and \( W(R) \). If the second correlation may be interpreted in this manner, another coherent pattern emerges:

(i) Slowing of the growth of aggregate labor supply causes a tightening of blue collar labor markets and acceleration of blue collar wage gains.

(ii) The growth of blue collar employment decreases and the wage system is used to place the greater part of the burden of decelerated employment growth upon low priority sectors (Group B and the wood products group). The correlation evidence of redistributive wage change disappears. Correlation evidence supporting allocative wage changes under conditions of tight supply appears where previously it was entirely absent.
Tightening of labor supply, it appears, is associated with enhancement of the allocative role of wage structure at the expense of redistributive objectives. This, it should be observed, applies to the period of a substantial wage reform which, by its narrowing of skill differentials within occupations, evidenced equalizing distributive goals. Wage structure involves many dimensions and relationships, some of which, apparently, were manipulated for distributive purposes while others served allocative ends.

3. Among ITR's, we observe what appear to be similar employment developments, but quite different wage changes. The difference appears to speak to central issues in this report.

On the employment side, variance of ITR employment growth rates increased markedly: while the (unweighted) mean growth rate for our sample of branches decreased from 30.9 to 24.3 per cent (1950-55 vs. 1955-60), the standard deviation of branch growth rates increased by more than 50 per cent and the coefficient of variation (of branch N(I) percentage increases over the two five-year periods) almost doubled. As in the blue collar case, this increase in variance during a period of decelerating employment growth involved disproportionate decreases of N(I) in the (evidently) low priority areas of Group B plus wood products. While in industry as a whole, the growth rate of ITR employment declines from 28.9 per cent to 22.0 per cent over the two five-year periods, the wood products group experiences a drop from 27.9 per cent to 4.2 per cent; light industry has a drop from 28.3
II-87

per cent to 2.3 pe4 cent; and foods other than sugar, meat, and fish, from 15.3 per cent to 6.0 per cent. Among other branches in Group A, only coal experiences a comparable decline, and several show increases in N(I). The similarity to the blue collar pattern presumably reflects the system by which Tables of Organization were planned.

ITR wage behavior is distinctive in two ways. First, there was no important acceleration of wage gains: the increase in W(I) was negligible. Second (and not coincidentally, we believe), there was no shift in wage structure in favor of the higher priority, more rapidly expanding branches. The strong positive correlation between N(I) and W(I) that appeared in 1950-55 and which we associated with an allocative role during a tight market for ITR's, disappears: the Pearson product movement correlation coefficient drops from +0.57 to -0.04 and is clearly insignificant. On the other hand, the rank order correlation between wage level at the start of the period, W(I)55, and the percentage increase in wage level over the whole five-year period, W(I), shifts from +0.12 to -0.17, with neither approaching persuasive levels of significance. Nevertheless, the two correlation coefficients shift in directions which suggest a change in the role of the interbranch structure of ITR wages--from an allocative to a distributive one.

These changes--assuming them to be real--are opposite to those observed in the case of blue collar workers. The shifts in the rabochiy case we associated with tightening of the supply of blue collar labor. In the ITR case, we also observe a slowdown in the growth of employment, which is accompanied by an even sharper shift in employment patterns. This shift, apparently, is largely tied to
the blue collar one; unlike the latter shift, it does not appear to reflect a supply constraint. The graduation of engineers and technicians in industrial specialties decelerated slightly (from a 10.5 per cent p.a. growth rate in 1950-55 to 9.3 per cent in 1955-60), but by less than the slow down in ITR slot creation. More telling, presumably, is the sharp increase in the growth rate of VUZ diploma-holders employed in industry—from 8.3 per cent p.a. in 1950-55 to 14.0 per cent p.a. in 1955-60—during this period of decrease in N(I).¹⁰

It therefore appears that in the market for specialists, supply conditions were easing during this period. This circumstance we associate with reduction in the use of wage structure for interbranch allocation of labor.

4. Consideration of developments in blue collar and specialist labor markets separately yields clear impressions concerning the underlying causes of change in the wage ratio, W(R)/W(I). Market forces, i.e., changing relative scarcities, appear to have been strongly involved. The combination of tightening in the blue collar market and relative slack in the specialists' market produce in the 1955-60 period the fastest pace of increase in the wage ratio, 2.28 per cent p.a., appearing in any of our subperiods of the 1950-78 span. At the branch level, the wage ratio changes with the impact upon each branch of what appears to be allocative changes in the branch structure of blue collar wages and distributive changes in the branch structure of ITR wages.
C. 1960-1966

1. The demographic base of the labor force recovered rapidly during this period, annual increments rising from -150,000 in 1960 to 1.5 million in 1966. Outflow of manpower from agriculture continued at a rapid pace, annual average employment declining by 1.6 million (after a decline of 1.7 million over 1950-55). A distinctive aspect this time is the very slow growth of blue collar employment in basic construction—up by less than 400,000 over a six-year period (7.9 per cent, or 1.27 per cent p.a.), compared to the 1955-60 increment of 1.7 million (10.11 per cent p.a.). This suggests that other sectors of the economy, including industry, were receiving substantial inflows of labor from construction and/or directly from agriculture. The effect was a substantial increase in absolute increments to the blue collar workforce in industry. Although the average annual percentage growth rate of such employment remained virtually unchanged, it seems clear that labor supply was less constraining in the non-agricultural sector during this period than it was in 1955-60.

Much more distinctive of this period is the enormous increase in ITR employment in industry that took place. The average annual growth rate of such positions increased from 3.4 per cent in 1955-60 to 7.4 per cent in 1960-66. This produced by far the fastest rate of increase in the employment ratio, $N(I)/N(R)$, experienced in any of the subperiods of our data. On the other hand, the supply of specialists
to industry appears to have grown at a much slower pace than did the number of professional slots. In the preceding period, 1955-60, the number of VUZ and SSUZ graduates employed in industry increased by 930,000, while the number of ITR's and sluzhashchiye increased by only 422,000. Considerable upgrading of white collar staff must have occurred. In 1960-66, the number of specialists employed in industry grew by 1,080,000 and the number of white collar slots grew by more than 1.2 million. Graduation data give the same picture: During 1955-60 there were approximately three VUZ and SSUZ graduations in industry-related specialties per net addition to the ITR ranks; in 1960-65, there appear to have been less than 1.8. It therefore seems clear that 1960-66 was a period of strong demand for specialists, in marked contrast to the preceding period.

In comparison with the preceding period, relative scarcities seem to have changed in ways which would lower \( W(R) \), raise \( W(I) \), and substantially lower the rate of increase (or decrease) of the wage ratio, \( W(R)/W(I) \). These developments did indeed take place: \( W(R) \) declined from 3.3 to 2.5 per cent p.a.; \( W(I) \) increased from 1.0 to 2.0 per cent p.a.; the wage ratio increased by 3.0 per cent over this six-year period, compared to a 12.0 per cent increase over the preceding five years. (Again, it is not clear why \( W(I) \) does not increase more rapidly than \( W(R) \), based solely upon changing relative scarcities.)
2. With respect to this distribution and remuneration of blue collar labor, there appear to be several distinctive developments. One is the sharp acceleration of $N(R)$ in the high priority, "progressive" branches of Group A--electric power, chemicals, and machine building and metal working. The share of these three branches in total industrial blue collar employment increased only slightly between 1955 and 1960, from 32.7 to 35.0 per cent; by 1966, however, their share had jumped to 40.5 per cent. Of particular interest is the fact that this rather substantial shift in employment structure was accomplished without distinct wage pressure in these branches. This is consistent with earlier evidence on the relationship between adequacy of labor supply and the allocative role of relative wages.

A second distinctive aspect is the sharp decline in the growth rate of blue collar employment in construction (from 10.1 per cent in 1955-60 to 1.3 per cent in 1960-66) and related branches of industry--timber, woodworking, and building materials. The share of these branches in total blue collar employment in industry and construction decreased from 34.3 to 30.4 per cent between 1960 and 1966. In only one of the affected branches (the cement component of building materials) does $W(R)$ decline noticeably relative to the all-industry figure. Presumably, demand for rabochye was much weaker in these branches than was typical in the rest of industry. This weakness of demand, however, does not seem to affect the wage structure.

Third, we may note that the group of branches--light industry, "other foods", and the wood products group--which experienced
distinctive declines in $N(R)$ between 1955 and 1960—do not share a common employment pattern in this period: One branch ("other foods") experiences a substantial employment gain; the other two show further, but moderate, decreases in $N(R)$. Nevertheless, all three experience relatively high rates of wage increase during 1960-66. The other major low-wage branches—building materials other than cement and the sugar and meat components of the food branch—experience similar rates of wage increase during this period. In each case, $N(R)$ declines over the period, in contrast to the constancy of this variable in industry as a whole (comparing 1960-66 with 1955-60). Considering the general state of manpower supply during this period, these decelerations of employment growth presumably reflect demand rather than supply peculiarities of these branches. Their distinct increases in relative wage level are therefore hard to understand from a market perspective.

We have identified three substantial, distinctive developments in the allocation and remuneration of blue collar labor in the 1960-66 period. In none of the three do we see the combination of employment and wage changes indicated by what we understand to be the changing pattern of relative scarcities during the period. This suggests the possibility that distributive rather than allocative functions dominated changes in blue collar wage structure during the period.

The distributive aspect we have considered in this regard is interbranch wage differences; and the indicator we have used of policy to limit, if not absolutely to reduce, these differences is the relationship between $W(R)$ and wage level at the start of the period,
W(R)60, in this case. Rank order correlation of these variables in the 1950-55 period was negative and very strong (significant at the .025 level) indicating an equalizing tendency. In 1955-60, this relationship disappears entirely. In this period, 1960-66, it reappears, and is statistically stronger than in 1950-55; the Spearman rank order correlation is -0.54, with a z value of -2.35 (significant at the .02 level). This occurs in a period when the major identifiable employment and wage movements do not appear to coincide from an allocative perspective. Also to be considered is the fact that the relationship we have associated with allocative wage changes—that between N(R) and W(R)—is weaker in this period than in either of the two earlier periods. (Pearson product moment correlation coefficient is -0.26 with a t value of -1.11. This figure, it should be noted, is more than negligible.)

We are led to the view that changes in the structure of blue collar wages during this period were dominated by distributive rather than allocative purposes. Based upon previous discussion, we would associate this with the rapid recovery of manpower supply during the period: easing of labor markets made it possible to achieve even ambitious employment targets in the high priority branches of Group A without competitive wage pressures.

3. **ITR** wage and employment developments at the branch level are very challenging. For the first time in our sequence of periods, \( \dot{N}(I) \) and \( \dot{W}(I) \) are inversely correlated, and strongly so. (Product moment coefficient of -0.49, significant at the .05 level.) For reasons
that have been explained, this is consistent with a market model in
which (a) ITR's represent holders of well-defined skills that are
priced and allocated in labor markets; (b) these skills are substan-
tially specialized by branch; and (c) cross-sectional differences in
rates of growth of supply (rather than of demand) are the dominating
market development during the period.

At the same time, however, we observe a strong inverse relation-
ship between W(I) and W(I)60. (Spearman's rank order correlation
coefficient is -0.68, significant at the .01 level.) This, we have
argued, is consistent with a distributive policy of limiting or
reducing inter-branch wage differences. Thus, the ITR wage and
employment data for this period seem to offer support for both our
primary (or naive) allocative hypothesis and for the distributive
alternative.

This is doubly troubling because our previous analysis would
lead us to have little confidence in the applicability of either
of these models to this period. The naive market model should not
apply because, to the extent that market forces are at work, ITR
wage movements reflect developments in markets for specialists,
not for ITR's. ITR employment changes may therefore bear little
relation to developments in the relevant labor market(s). This, at
least, is the argument of earlier sections.

When we pursue this approach, we discover no evidence of inter-
branch supply variation which would produce the observed pattern of
wage changes in this period. For example, production of specialists
(by VUZy and SSUZy) for the sectors of relatively slow employment
gains and rapid ITR wage increase (food, wood products, light industry) did not decelerate relative to the all-industry rate.\textsuperscript{12} To the extent (a) that ITR's in general, and new graduates in particular, are specialized by branch and (b) that the growth rate of new graduates in the sector is an index of rate of change in supply, the graduation statistics do not indicate a supply shift in this period away from the major sectors which experienced relatively rapid wage gains and slow employment increase. If supply variation is determining, therefore, it would have to involve inter-branch shifts on non-wage grounds. This may have occurred, but we have no evidence of it. The conformity of the employment and wage changes with the naive, supply-dominated market model may therefore be discounted.

Also troublesome is the period's statistical support for the (equalitarian) distributive hypothesis. Previous discussion would lead us not to expect such redistribution when labor markets are tight: under such conditions, we have argued, wage structure tends to be used to assure adequate labor supply to high priority branches; i.e., allocative rather than distributive objectives dominate.

As has been indicated, there is evidence that, in the aggregate, this was a period of tight markets for specialists. The question we turn to now is whether or not the data offer evidence that wage changes played a role in allocating this relatively scarce factor at the branch level.

A useful indicator of relative scarcity across branches is the ratio of (a) net growth of ITR slots in each branch to (b) net increase in the number of specialists employed, or $D(I)/D(S)$. The
numerator may be interpreted as an indicator of branch demand for specialists; the denominator indicates the extent to which demand is being met.

If credential-bearing specialists are substantially specialized by branch (i.e., if they are not readily substitutable across branches), cross-sectional variation in \( \dot{W}(I) \) should be positively related to the size of the \( D(I)/D(S) \) ratio. This ratio, in other words, can serve as an index of inter-branch variation in relative supply of qualified personnel: If the ratio is high, there is a short-fall of supply which we would expect to be associated with relatively strong upward wage procedure.

The data on branch employment of specialists are not as extensive as our other employment data (breakdowns of the building materials, food, and wood products groups are not available, leaving us with 11 branches of industry plus construction), but they permit a limited exploration of these notions. We find, first of all, a more than negligible and negative rank order correlation between the rate of increase of ITR wages, \( \dot{W}(I) \), and the size of the \( D(I)/D(S) \) ratio. (The rank order correlation coefficient is \(-0.25\), with a z value of \(-0.83\); this would be significant at only the .40 level.) If this result can be taken at all seriously, it suggests that our conception of separate, branch-specific markets for specialists is erroneous (since that would appear to be a reasonable indicator of labor market tightness (by branch) is negatively related to the rate of wage change). It is more consistent with a world in which specialists are highly substitutable across branches and demand differences play the major role.
That is, wages rise more rapidly in those branches in which there is the greatest "success" in upgrading the ITR staff—in raising, at the margin, the ratio of credential-holding specialists to the total ITR staff. In a period of over-all tightness of "the" market for specialists, such quality improvement would presumably be relatively expensive; and the willingness to undertake it would be a measure of effective demand for specialists. The negative relationship, if it can be credited, is therefore consistent with a market model in which specialists are mobile between branches, differences in demand are determining, and the over-all market for specialists is "tight".

This does not appear to be an unrealistic characterization of conditions in the 1960-66 period. Support for "the market" may therefore be found in the ITR employment and wage developments of this period. On the other hand, we should note the following:

(i) The negative relationship we refer to is not statistically significant at any conventionally acceptable level.

(ii) There is a much stronger cross-sectional relationship between the D(I)/D(S) ("market tightness") ratio and change in the wage ratio, \( \dot{W}(R) - \dot{W}(I) \). The rank order correlation coefficient in this case is -0.61, with a z value of -2.04 (significant at the .05 level). This means that the wage ratio, \( W(R)/W(I) \), is more sensitive to our measure of market tightness than is the pace of ITR wage change by itself. This may be interpreted in various ways. One is that the strong distributive element which we found in blue collar wage movements in this period influenced ITR wage changes as well.
That is, the results of these two correlations suggest that variation in demand for specialists (as we have measured it) tends more strongly to cause variation in ITR wage changes about the distributive (rabochiy) pattern, than in ITR wages themselves. In short, the 1960-66 data make it hard to escape the conclusion that both ITR and blue collar wage movements reflected distributive objectives. However, there is some evidence that ITR wage changes involved allocative aspects as well.

4. The 1955-60 interval showed a very small increase of the employment ratio N(I)/N(R), and a very large jump in the wage ratio, W(R)/W(I). An explanation for this superficially anomalous outcome was offered which relied upon relative abundance in markets for specialists. 1960-66 saw the largest increases in N(I)/N(R) and the smallest of increases in W(R)/W(I). Here, too, changing relative scarcities provide useful explanation: there was an easing of aggregate (blue collar) labor supply and a severe tightening in markets for professionals. (For reasons that are not clear, the number of white collar slots created increased discontinuously; the stock of specialists did not.)

At the branch level, we see, for the first time, a handful of branches in which the wage ratio, W(R)/W(I) decreases. Cross-sectionally, the magnitudes of changes in this ratio are inversely correlated with the size of another ratio: that of incremental ITR slots created during the period, D(I), to growth in the number of specialists employed, D(S). The latter ratio appears to be more a
measure of effective demand for specialists in general than it is of supply of branch-specialized professionals. This strong negative relationship may mean that there was a tendency for \( \dot{W}(I) \) to rise relative to \( \dot{W}(R) \) in those branches that were doing the most upgrading of their ITR staffs in the generally tight professional labor markets of this period. The relationship of \( \dot{W}(I) \) to changes in blue collar wage levels suggests a within-branch wage structure involving the wage levels of these two major employment categories.
Table 6. Summary of Correlation Calculations

<table>
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<th>r</th>
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<th>t or z</th>
<th>Prob. value</th>
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<tbody>
<tr>
<td>I. Rabochiy and ITR wage levels</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>A. Correlation of branch levels of W(R) and W(I), 1950</td>
<td>+0.93</td>
<td>18</td>
<td>10.7</td>
<td>&lt;.001</td>
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<td>B. Correlation of branch levels of W(R) and W(I), 1966</td>
<td>+0.91</td>
<td>18</td>
<td>9.3</td>
<td>&lt;.001</td>
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<tr>
<td>II. Changes in branch wage and employment ratios, 1950-66</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>A. Correlation of ( \dot{W}(R) ) and ( \dot{W}(I) )</td>
<td>+0.78</td>
<td>18</td>
<td>5.29</td>
<td>&lt;.01</td>
</tr>
<tr>
<td>B. Correlation of ( \dot{N}(R) ) and ( \dot{N}(I) )</td>
<td>+0.62</td>
<td>18</td>
<td>3.35</td>
<td>&lt;.01</td>
</tr>
<tr>
<td>III. Rates of wage increase and employment changes, 1950-66</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A. Correlation of ( \dot{W}(R) ) and ( \dot{N}(R) )</td>
<td>+0.03</td>
<td>18</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A'. Correlation of ( \dot{W}(R) ) and ( \dot{N}(R) ) (r.o.)</td>
<td>-0.09</td>
<td>18</td>
<td>-0.38</td>
<td>0.70</td>
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<td>B. Correlation of ( \dot{W}(I) ) and ( \dot{N}(I) )</td>
<td>+0.21</td>
<td>18</td>
<td>0.91</td>
<td>&lt;.04</td>
</tr>
<tr>
<td>B'. Correlation of ( \dot{W}(I) ) and ( \dot{N}(I) ) (r.o.)</td>
<td>-0.04</td>
<td>18</td>
<td>-0.18</td>
<td>0.86</td>
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<tr>
<td>C. Correlation of ( \dot{W}(I) ) and changes in ( \frac{N(I)}{N(R)} )</td>
<td>+0.21</td>
<td>17</td>
<td>0.89</td>
<td>&lt;.04</td>
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<tr>
<td>IV. Wage and employment ratios</td>
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<tr>
<td>A. Correlation of ( \frac{N(I)}{N(R)} ) and ( \frac{W(R)}{W(I)} ) ratios, 1950</td>
<td>+0.20</td>
<td>17</td>
<td>0.83</td>
<td>&gt;.4</td>
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<td>B. Correlation of changes in these ratios, 1950-66</td>
<td>+0.34</td>
<td>17</td>
<td>1.49</td>
<td>&lt;.02</td>
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<td>V. Wage level, 1950 and percentage changes, 1950-66</td>
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<tr>
<td>A. Correlation of ( \dot{W}(R) ), 1950 and ( \dot{W}(R) )</td>
<td>-0.45</td>
<td>18</td>
<td>-2.14</td>
<td>&lt;.05</td>
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<td>A'. Correlation of ( \dot{W}(R) ), 1950 and ( \dot{W}(R) ) (r.o.)</td>
<td>-0.52</td>
<td>18</td>
<td>-2.25</td>
<td>&lt;.03</td>
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<td>B. Correlation of ( \dot{W}(I) ), 1950 and ( \dot{W}(I) )</td>
<td>-0.25</td>
<td>18</td>
<td>-1.09</td>
<td>&lt;.3</td>
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<td>B'. Correlation of ( \dot{W}(I) ), 1950 and ( \dot{W}(I) ) (r.o.)</td>
<td>-0.44</td>
<td>18</td>
<td>-1.85</td>
<td>&lt;.07</td>
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<tr>
<td>VI. Employment and wage changes, by subperiods</td>
<td></td>
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<td></td>
<td></td>
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<tr>
<td>A. 1950-1955: Correlation of ( \dot{N}(R) ) and ( \dot{W}(R) )</td>
<td>-0.34</td>
<td>17</td>
<td>-1.49</td>
<td>&lt;.2</td>
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<td>B. 1955-1960: Correlation of ( \dot{N}(R) ) and ( \dot{W}(R) )</td>
<td>+0.57</td>
<td>16</td>
<td>2.78</td>
<td>&lt;.02</td>
</tr>
<tr>
<td>C. 1960-1966: Correlation of ( \dot{N}(R) ) and ( \dot{W}(R) )</td>
<td>+0.04</td>
<td>16</td>
<td>0.16</td>
<td>&gt;.8</td>
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<td>VII. Initial wage levels and percentage change, by subperiods</td>
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<tr>
<td>A. Rabochiy: ( \dot{W}(R) ), 1950-55 (r.o.)</td>
<td>-0.52</td>
<td>18</td>
<td>-2.25</td>
<td>&lt;.02</td>
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<tr>
<td>( \dot{W}(R) ), 1955-69 (r.o.)</td>
<td>-0.01</td>
<td>18</td>
<td>-0.05</td>
<td>-</td>
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<tr>
<td>( \dot{W}(R) ), 1960-66 (r.o.)</td>
<td>-0.54</td>
<td>18</td>
<td>-2.35</td>
<td>&lt;.02</td>
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<tr>
<td>B. ITRs: ( \dot{W}(I) ), 1950-55 (r.o.)</td>
<td>+0.12</td>
<td>18</td>
<td>0.53</td>
<td>&lt;.60</td>
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<tr>
<td>( \dot{W}(I) ), 1955-60 (r.o.)</td>
<td>-0.17</td>
<td>18</td>
<td>-0.73</td>
<td>&lt;.47</td>
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<tr>
<td>( \dot{W}(I) ), 1960-66 (r.o.)</td>
<td>-0.68</td>
<td>18</td>
<td>-2.98</td>
<td>&lt;.01</td>
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Table 6. Summary of Correlation Calculations - cont'd.

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<th>t or Z</th>
<th>Prob. value</th>
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<tr>
<td>VIII. ITR wages and the market for specialists, 1960-66</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A. Correlations of (\dot{W}(I)) and (\Delta N(I)/\Delta specialists) employed; (\text{(r.o.)})</td>
<td>-0.25</td>
<td>10</td>
<td>-0.83</td>
<td>(&gt; 0.40)</td>
</tr>
<tr>
<td>B. Correlations of (W(R) - W(I)) and (\Delta N(I)/\Delta specialists) (\text{(r.o.)})</td>
<td>-0.61</td>
<td>10</td>
<td>-2.04</td>
<td>(&gt; 0.04)</td>
</tr>
</tbody>
</table>

Notes: Correlation coefficients of two sorts have been calculated: Conventional, zero-order product moment correlation coefficients and Spearman rank order correlation coefficients. The latter are indicated by \(\text{(r.o.)}\).

The test statistic applied to the product moment correlation coefficients is \(\frac{r\sqrt{n - 2}}{\sqrt{1 - r^2}}\) which has a \(t\) distribution with \(n - 2\) degrees of freedom when the population correlation coefficient equals zero.

The test statistic applied to rank order correlation coefficients is \(\sqrt{n - 1}\) which is approximately a standard normal variable \(Z\) when sample size is fairly large and the underlying population correlation coefficient is zero. Given the sample sizes with which we are working, this test statistic is applied here with reservations.

The prob. values show the probability that, if the null hypothesis of zero correlation in the underlying population is correct, a sample \(r\) as large as (or larger than) that observed would occur solely because of the chance element in random sampling. Thus, a prob. value of 0.05 indicates that there is less than a 5 percent chance of observing an \(r\) this large when sampling from a population in which the value of the corresponding parameter is zero. As indicated, the precision of this interpretation is subject to doubt.
V. Summary and Conclusions

1. The subject of this report is the allocative role of relative wages, with special reference to professional manpower, in the postwar Soviet economy. The empirical focus of the study is upon the long-term decline in the average earnings of white-collar workers ("Engineering-technical personnel", ITRs in particular) relative to those of blue-collar workers (rabochiye) in Soviet industry and construction. In industry (i.e., manufacturing and mining), the average monthly earnings of the ITRs decreased from 176 per cent of those of rabochiye in 1950 to 118 per cent in 1978. In construction, the decrease was sharper: From 212 per cent in 1950 to 108 per cent in 1978.

These developments are subject to two principal, competing interpretations. On the one hand, they may be viewed as the outcome of market forces: relative wage levels respond to changing relative scarcities, the rapidly growing supply of persons qualified for ITR positions, in particular. In this view, wages play an important allocative role, demanders and, perhaps, suppliers of different labor services reacting to relative wage rates in making occupational and employment choices. An alternative interpretation emphasizes the role of distributive policy in shaping Soviet wage structure. In this view, the decline in the relative wage of white-collar workers is primarily a reflection of long-standing Soviet policy to reduce inequality in the size distribution of income and to increase the rewards of proletarians relative to those of the intelligentsia (whose advanced training has been financed almost completely by the State). Allocation, it may be argued, is influenced by other means: non-wage remuneration, moral suasion, coercion, etc.
These hypotheses, and variants of them, are explored with reference to wage and employment data, in varying degrees of temporal and sectoral disaggregation, for the period 1950-1978. This was a period of marked swings in the demographic base of the Soviet labor force, in the intersectoral flows of manpower (especially among agriculture, construction, and industry), in the branch structure of industrial employment, and in the educational attainment of the labor force. If wage structure played a substantial role in accommodating these changes—in signalling the shifting patterns of supply and demand—we expect that this would be reflected in the wage and employment data at our disposal. If, on the other hand, wage structure was used to promote distributive rather than allocative purposes, we should be able to discern this as well.

As the Soviet economy enters another period of manpower stringency, prospects for alternative methods of adaptation may well be illuminated by experience of the recent past. We examine that experience (i.e., wage and employment movements) from three perspectives involving differing degrees of temporal and branch disaggregation:

(a) 1950-78 with temporal, but no branch, disaggregation;
(b) 1950-66 with branch, but no temporal, disaggregation;
(c) 1950-66 with branch and temporal disaggregation.

2. Over the period 1950-78, the ratio of average ITR wage to average blue collar wage decreased by one-third. Over the same period, the number of ITRs employed per 100 industrial rabochiy employed increased by about 60 per cent (from 10.1 to 16.4). The number of "specialists" (comprising "technicians", or graduates of Specialized Secondary Schools, and "engineers", or graduates of higher technical institutions) employed in the economy also expanded enormously: at an average rate of 10.2 per cent per annum (1955-77). This
combination of changes in relative wages and relative scarcities is consistent with the operation of market forces in a competitive setting.

However, the distribution of these wage and employment changes over time raises questions. In the industrial sector, we do not find that the average rabochiy wage, \( W(R) \), rose especially rapidly relative to that of ITRs, \( W(I) \), during periods of rapid increase in the \( \text{ITR/rabochiy} \) employment ratio, \( N(I)/N(R) \). If anything, the relationship is negative. (In construction, there is almost perfect inverse rank order correlation of periods by magnitude of increase in \( W(R)/W(I) \) and in \( N(I)/N(R) \). This discussion refers to a division of 1950-78 into five five-year periods and a concluding three-year period.)

Indeed, the most striking feature of the wage and employment series for industry as a whole is the 1960-70 surge in both white collar employment and wages (absolutely and relative to their blue collar counterparts). Among ITRs, there is a sharp acceleration of employment growth (to 6.3 per cent p.a., from 4.6 per cent in the preceding decade) and a sharp jump in the rate of wage increase (from about one-third of the percentage growth rate of \( W(R) \) to more than two-thirds). Among the other major category of white-collar workers, office and administrative workers, both the employment and wage accelerations are sharper. In fact, during 1960-70, the rate of wage increase for this employment category exceeded that of blue-collar workers, an extraordinary phenomenon in postwar Soviet experience.

In a dynamic market setting, the combination of rapid (absolute and relative) employment and wage increases for white collar workers would suggest that strong demand, rather than supply, was the dominant market force. Indeed, viewing the 1950-78 period as a whole, period-to-period variation in wage structure is more satisfactorily explained by period-to-period variation.
in demand than in supply. Furthermore, wage movements suggest that more than half of the overall increase in the employment ratio, \(N(I)/N(R)\), is more readily associated with demand growth relative to supply than vice versa. (Of the 1950-78 increase of 6.3 in the number of LTRs per 100 rabochiye, 3.5 or 56 per cent, is attributable to the 1960-70 decade.)

Independent evidence that the 1960-70 surge in white collar wages is a market phenomenon is to be found in the relationship between the growth of white collar employment in this period and growth in the employment of specialists (credentialled professionals). The massive expansion of professional education notwithstanding, this decade saw absolute growth of specialist employment in industry barely keeping up with absolute growth in white collar employment. (In the preceding and succeeding periods for which we have data, the former exceeded the latter by well over 100 per cent.) In addition, the ratio of specialist graduations from specialized secondary and higher educational institutions (SSUZy and VUZy, respectively) to incremental white collar employment was distinctly low during 1960-70.

These data suggest that tight markets for specialists during the 1960's accounted for the upward pressure on white collar wages (relative to blue collar). In attempting to fill the large number of white collar positions that had been created, enterprises competed for the limited supply of professionally qualified personnel. (Resort to training and promotion of personnel lacking professional education, known as praktiki, was widespread, but presumably involved significant costs.) If this interpretation is correct, it implies that white collar wages are influenced by supply and demand for qualified specialists; that the number of white-collar slots created is a measure of demand for specialists, rather than a wage-sensitive
market outcome. In other words, the growth in white collar employment, 1950-78, is not the relevant indicator of altered relative scarcity; instead, that measure is the changing relationship between white collar employment (slots) and the stock of employed specialists.

At this level of aggregation, the data support the notion of allocative wage relationships responding to market forces in a particular, but not unfamiliar, manner. It is not clear, however, why in the period of especially tight markets for specialists, the blue collar wage rate should have increased more rapidly than the average ITR wage. What we may be observing is market forces causing variation about a longer-term distributive trend.

3. Further evidence on the allocative and distributive roles of wage structure is provided by branch wage and employment data for the period 1950-66. During this major interval of the 1950-78 period, the trends upon which we are focusing were strongly in evidence: the ratio of the average wage of industrial rabochiye, $W(R)$, to that of ITRs, $W(I)$, increased from 0.57 to 0.70; the number of ITRs per 100 rabochiye increased by 29 per cent.

The starting point of our analysis is the cross-sectional pattern in 1950. This reveals substantial, systematic variation in wage and employment structure. Most important are (a) the strong correlation of $W(R)$ and $W(I)$ across branches; and (b) the correlation of branch wage level (both $W(R)$ and $W(I)$) with the employment ratio, $N(I)/N(R)$. That is, low wage branches--Group B (food and light industries) and the wood products group--tended to have few ITRs per 100 rabochiye. Heavy industry tended to have above average wage levels and $N(I)/N(R)$ ratios. Interbranch variation in wage levels (and ratios) was much less than variation in employment structure, and no relationship was evident between the wage ratio, $W(R)/W(I)$ and the employment ratio, $N(I)/N(R)$. 
That is, there is no cross-sectional tendency for the proportions in which white- and blue-collar workers are employed to be associated with their relative prices. These observations raise doubts concerning the allocative role of relative prices for different grades of labor.

On the other hand, the cross-sectional pattern of average wage levels corresponds closely to that found in a major market economy, that of the United States, in the same year. (Comparison with the American economy at an earlier period is presumably more apt. See A. Bergson, The Structure of Soviet Wages, Harvard University Press, 1948). The only substantial discrepancy between the two branch orderings relates to the construction sector, which had a relatively high average wage level in the U.S. and a relatively low one in the Soviet Union. We also observe that the pattern of branch wage levels is correlated with background characteristics of the labor force—education, age, sex, experience—very much as predicted by human capital theory and as observed in Western market economies.

Turning to changes over time, comparison of beginning and end-year data offers little confirmation of the market (relative scarcity) hypothesis. The allocative significance of the wage ratio is brought into question by several factors. One is the strong correlation of W(I) with W(R) changes as well as of N(I) and N(R) changes over the period. Another is the fact that the wage ratio, W(R)/W(I), increases in all branches including those in which the employment ratio, N(I)/N(R), decreases. This, of course, is inconsistent with the notion that the relative wage of ITRs is being depressed by their increasing relative availability. There is some tendency for the magnitudes of changes in the two ratios to be positively correlated, which might suggest the possibility that market forces make themselves felt as variation about a trend toward higher relative wages for blue collar workers. However, closer
examination indicates that this correlation is a byproduct of what appear to be distinct sectoral policies on wages and employment: Group B branches tend to have low rates of employment growth and low (or negative) increases in N(I)/N(R); these branches tend to have rapid rates of wage increase, but with no pattern in regard to the wage ratio, W(R)/W(I). Heavy industry, on the other hand, tends to have rapid employment gains, above average increases in N(I)/N(R), low rates of wage increase and no systematic pattern in the wage ratio.

The most distinct patterns therefore relate to changes in branch wage and employment levels rather than to changes in wage and employment ratios. Furthermore, changes in these levels tend to be inversely correlated: core branches of heavy industry had fast employment and slow wage growth; Group B plus wood products had distinctly slow employment growth and rapid wage growth. In a dynamic market context, these combinations suggest rapid supply increase (relative to demand) in the former group of branches and the reverse in the latter group. The available data on manpower supply during this period support neither of these inferences.

Other hypotheses concerning the pattern of changes in branch wage levels were explored. Most consistent with the data for the 1950-66 period as a whole is a distributive hypothesis, that branch wage changes were dominated by an effort to reduce interbranch wage variation. The evidence in support of this hypothesis is the strong negative correlation between the level of wages in the branch at the start of the period (1950) and the (percentage) rate of wage increase, 1950-66. Such correlation applied to blue collar and ITR wages (separately), but more strongly to the former.

Our analysis of branch wage and employment changes over this period as a whole suggests the existence of distinct sectoral employment and wage policies.
Employment policy evidently sought rapid expansion of core branches of Group A (machinery, chemicals, electric power) and upgrading of their labor forces (in terms of ITRs per 100 rabochiye). This produced a clear increase in the degree of inequality, across branches, in $N(I)/N(R)$ ratios. Especially striking is the absence of any apparent use of the wage system to accomplish these rather substantial changes in employment structure. Instead, wage policy seems to have been directed toward equalitarian distributive ends—the limitation, if not absolute reduction, of wage differences among branches and between major employment categories (ITRs, office and clerical personnel, blue collar workers).

4. The period for which we have disaggregated wage and employment data, 1950-1966, was a period of sharp swings in the growth rate of aggregate labor supply. Between 1950 and 1955, increments to the population in the able-bodied ages (males 16-59, females 16-54) were large and growing—from 1.3 million in 1951 to 2.6 million in 1955. Between 1955 and 1960, these increments shrank rapidly, reaching -150,000 in 1960. Recovery followed, the annual increment reaching 1.5 million at the end of the period. The existence of such an intense cycle in manpower supply raises the possibility that comparison of end-year data may miss a perhaps substantial role of wage structure in facilitating adaptation to sharply changing labor market conditions. Accordingly, we examined wage and employment data at the branch level for each of the three indicated subperiods, seeking evidence of such an adaptive role of Soviet wage structure. This analysis indicates striking changes in wage behavior which may well be associated with shifts in labor market conditions.
Consider first the data on blue collar workers. In 1950-55, when aggregate labor supply was abundant, total industrial employment (of rabochiye) grew rapidly (4.9 per cent p.a.) and the average blue collar wage increased relatively slowly (2.1 per cent p.a.). There was little change in the branch distribution of employment, but substantial change in the interbranch structure of wages. The latter change was of an equalizing sort: there was, in this period especially, strong inverse correlation between branch wage level at the start of the period (1950) and (percentage) rate of wage increase during the five-year period.

In 1955-60, with aggregate labor supply tightening, the growth rate of blue collar employment declines (to 3.7 per cent p.a.) and the associated rate of wage increase rises (to 3.3 per cent p.a.). Interbranch variance of employment growth rates increases sharply, with core branches of heavy industry growing rapidly and Group B and wood products slowly. The evidence of distributive wage policy disappears. Instead, positive correlation appears between branch growth rates of blue collar employment, N(R), and of average wage rate, W(R). Thus, the "burden" of slower employment growth is placed upon what have often been viewed as low priority branches; and wage structure evidently is used to implement this policy: rates of wage increase in Group B and wood products decelerate relative to those in heavy industry.

In 1960-66, the growth rates of aggregate labor supply and of industrial employment rise, while that of W(R) declines slightly. The branch structure of blue collar employment continues its marked shift toward heavy industry, but the evidence of use of wage structure for this purpose—positive correlation between rates of increase of W(R) and N(R)—vanishes. Instead, we see again strong evidence of distributive policy (in the form of strong negative correlation between initial level and growth rate of W(R), across branches).
This sequence is highly suggestive. Especially noteworthy is the strong evidence of distributive policy at work during the first and the last of the three subperiods. These were the periods during which aggregate labor supply was relatively abundant and increasing. The intervening five-year period was marked by slower growth of aggregate labor supply and of industrial employment; also by increased variance of branch growth rates, as the scarcity of labor is distributed very unequally across branches. It is only during this period that evidence of allocative use of wage structure appears: a positive relationship between the rates of growth of employment and wages (of blue collar workers), which is what one would expect in tightening markets for a factor that is highly substitutable across branches. In the absence of such pressures on labor resources, it appears, a policy of reducing (or limiting) inter-branch inequality of average wage rates was pursued without adverse effect on employment objectives. An interesting contrast with Western experience emerges: interbranch inequality increases, rather than decreases, when labor markets tighten.

This general interpretation appears to find support in the ITR data. In the first subperiod, 1950-55, demand for professional manpower was very strong. This is suggested by the rapid growth of blue-collar employment (on the basis of which the number of ITR slots is planned) and by the number of ITR slots created relative to the number of professionals graduated during the period. The apparent tightness of supply is associated with strong positive correlation between rates of change of ITR employment and wages across the 18 branches for which we have data. As might be anticipated, interbranch equalization of wage levels is totally absent.
These results are consistent with our analysis of blue-collar wage movements. That is, tight markets are associated with evidence of allocative wage changes; (equalizing) distributive changes do not appear. However, earlier discussion indicated that ITR wage movements are importantly influenced by the relationship between the supply of specialists and the rate of creation of ITR positions. In the absence of data on the branch distribution of specialists during this period, we cannot explore this aspect.

Labor market conditions in the succeeding period are markedly different, and the wage pattern also changes. The growth rate of ITR employment declines (from 5.2 to 4.1 per cent p.a.), the inter-branch variance of branch growth rates rises, and lower priority sectors (Group B and wood products) experience the largest decreases. However, we do not see the intensification of the allocative role of relative wages that we might have been led (by previous discussion) to anticipate. Instead, statistical evidence of such disappears and evidence (admittedly weak) of distributive wage policy appears. This shift appears to be associated with a simultaneous change (increase) in the availability of credentialed specialists relative to the number of ITR positions created during the period. That is, we see again the disappearance of the evidence of allocation by relative wage changes when scarcity abates. However, this is an aggregate relationship; we are again limited by the absence of branch data on specialist supply.

The concluding period, 1960-66, is especially challenging, and may not be satisfactorily explained by the general notions developed in preceding analysis. Two patterns are especially problematic, neither of which, based upon preceding arguments, appears to be consistent with the general state of
the market for professional manpower during this period—considerable tightness. During this period, the growth rate of ITR positions in industry as a whole rose to 7.4 per cent p.a., from the rate of 4.1 per cent p.a. in 1955-60. Data on the availability of professionally trained specialists indicate no comparable growth.

Preceding discussion would lead us to expect a strong *positive* relationship, across branches, between growth rates of ITR employment, $N(I)$, and average ITR wage rate, $W(I)$. The first of the troublesome patterns to which we referred is the strong *negative* correlation between these variables which emerges from the data for this period. As indicated previously, in a dynamic market setting, this pattern would be associated with inter-branch variation in supply (i.e., in the rate of rightward shift of branch-specific supply curves) as the dominant market factor. This interpretation, however, is not supported by the available data on the production of (new) specialists. That is, the branches that experienced relatively large increases in $N(I)$, and small increases in $W(I)$, do not appear to have been the beneficiaries of especially large cohorts of graduates specialized to them. Therefore, on two grounds, the negative relationship between growth rates of $W(I)$ and $N(I)$ during this period is not consistent with expectations of the effect of changing relative scarcities in a market context.

The second troublesome pattern is the following: we find strong negative correlation, across branches, between $W(I)$ at the start of the period (i.e., in 1960) and the percentage rate of increase of $W(I)$ during the period. This relationship is consistent with implementation of a distributive wage policy aimed at limiting or reducing inter-branch wage differentials. However, our analysis of blue collar wage and employment patterns led us to associate such distributive wage policy with slack in
labor markets, rather than with the tightness that appears, at the aggregate level, to characterize the market for professionals during this period.

This quandary may be illuminated by an available indicator of cross-sectional variation in labor market conditions. Inter-branch variation in the ratio of ITR slots created (over this period) to net increase in specialist employment may be systematically related to changes in wage structure in a way which informs concerning these puzzling relationships.

The number of ITR slots created during the period may be viewed as an index of branch demand for specialists; net growth of specialist employment as an indicator of the extent to which that demand was satisfied. Our data suggest a negative relationship between (a) the size of this ratio and (b) the rate of ITR wage increase during the 1960-66 period. (The relevant correlation coefficient is more than negligible but not statistically significant at conventional levels.) That is, ITR wages tended to increase more rapidly in branches that were most successful in maintaining the representation of specialists among their ITRs. This is what we would expect to observe in a dynamic market setting when (a) the resource in question is highly substitutable across branches and (b) there is substantial interbranch variation in (growth of) demand for the resource. (Positive correlation of our indicator ratio with growth rate of \( W(I) \) would have suggested that the former was measuring variation in demand for a specialized resource: Wages are bid up most rapidly where demand increases most rapidly relative to inelastic supply of a branch-specialized resource.)

This analysis points to a significant conclusion: ITR wage and employment movements should not be thought of as outcomes (equilibrium or otherwise) of a market for ITRs. ITR employment reflects the rate at which
ITR positions are created in enterprise tables of organization, a process which bears no evident relationship to the (relative) level of ITR wages. The ITR wage level appears to reflect conditions in markets for specialists, formally trained professionals who represent only one source of supply for ITR personnel. Changes in the branch structure of ITR wages can be understood as the product of allocative market processes (i.e., as reflecting changing relative scarcities) when the distinction between ITR employment and specialist employment is made and the former is interpreted as a measure of demand for the latter.

At the same time, it must be noted that our indicator ratio bears a much stronger inverse relationship to change in the wage ratio, \( \frac{W(R)}{W(I)} \), than it does to change in the level \( W(I) \). Intra-branch wage structure, in other words, may act as a (distributive) constraint upon market-based changes in relative wages.

5. To summarize very briefly: the long-term decrease in the ratio of \( W(I) \) to \( W(R) \) appears, from our analysis, to be the outcome of two major, interacting factors. One is the changing relative scarcities of different grades of labor. The other is distributive policy directed toward the reduction of inter-branch and inter-group wage differences. There is substantial evidence that distributive policy is pursued vigorously only during periods of relative slack in labor markets. During periods of tight supply, an allocative wage pattern appears, which accommodates the diversion of the scarce factor to higher priority sectors (whose growth rate is thereby insulated against the change in labor supply). This accommodating wage pattern involves changes in overall branch levels; there is little evidence that the wage ratio, \( \frac{W(R)}{W(I)} \), plays a significant allocative role.
Concerning professionally trained manpower, we find that white collar employment levels are not the relevant wage-related, market quantity. Rather, white collar employment measures the creation of positions in enterprise tables of organization. Its usefulness in explaining changes in white collar wages seems to be greatest when it is interpreted as a measure of demand for qualified, credentialled specialists, rather than as a market outcome itself. Although our data are limited and the evidence less clear than we would like, interbranch wage movements for ITRs are most intelligible when associated with (cross-sectional) variation in demand for a factor that is highly substitutable across branches.

The data do not indicate that differences between white-collar and blue-collar wages were used as a signal to influence occupational choice by students. Nor is there evidence that relative wages significantly influence the rate at which white collar positions are created. It is in the rationing of existing stocks of specialists during periods of stringency that evidence of the allocative role of white collar wage levels appears.
FOOTNOTES

Chapter I


11. Ibid., p. 632.

12. Data on employment of specialists are from the same sources as listed in Footnote 6.


16. Thurow, Generating Inequality, op. cit., Chapter 5.

17. Piore and Doeringer, op. cit., Chapter VI.

18. Ibid.


20. Ibid. See also M.A. Ivanova and I.A. Samarina, Tekhnicheskiy progress i sluzhashchikh (Technical Progress and the Structure of ITRs and Office Workers), Moscow, 1970, pp. 53, 54.


Chapter II

1. An extraordinary Soviet analysis of the changing relationship between general educational and technical attainment, on the one hand, and the requirements of the economy, by branch, on the other is V. V. Krevnevich, Vliyaniye nauchno-tekhnicheskogo progressa na izmeneniye struktury rabocheho klassa SSSR (The Influence of Scientific-Technical Progress on the Change in the Structure of the Working Class of the USSR), Moscow, "Nauka", 1971.


3. K. P. Savichev, Podgotovka i raspredeleniye molodykh spetsialistov v SSSR (Training and Distribution of Young Specialists in the U.S.S.R.), Moscow, 1972, is a valuable discussion of these and related problems.


Chapter III


2. The coefficient of variation is the ratio of the standard deviation to the mean of a probability distribution.

3. Doeringer and Piore, op. cit.


5. Ibid., Table C-11. Note that the U.S. data refer to "spendable average weekly earnings, married worker with three children". Soviet data are average monthly earnings for all blue collar workers.

6. TSSU, Itogi . . . perepisi . . . 1959, op. cit., Table 40.

7. TSSU, Trud v SSSR, op. cit., pp. 235, 236.

8. TSSU, Itogi . . . perepisi . . . 1959, op. cit., Table 39.


10. Rapawy, op. cit., Table 11, p. 31, which is based on thoroughly searched Soviet sources.


12. Ibid., pp. 264, 265.


Chapter IV


2. TSSU, Narodnoye obrazovaniye . . ., op. cit., p. 93.

3. Rapawy, op. cit., Table 12.

4. Graduation data are from TSSU, Narodnoye khozyaystvo v SSSR (National Economy of the U.S.S.R.), v. 1978 (pp. 480, 481), v. 1972 (pp. 646, 647); TSSU, Kulturnoye stroitel'stvo v SSSR, Moscow, 1956, pp. 217, 241. ITR employment data are from TSSU, Trud v SSSR, op. cit., pp. 86, 87.

5. Rapawy, op. cit., p. 4.

6. Ibid., Table 12.


10. TSSU, Trud v SSSR, op. cit., pp. 264, 254. See also Footnote 4, this chapter.

11. See Footnote 4, this chapter.
Research Report on the Family

Part I. Introduction

The economic system of a society affects first of all the economic outcomes of social activity; the level and structure of output, the rate of growth, the distribution of income, and so forth. Those effects are the standard subject matter of economic analysis. However, the economic system also affects to some degree the outcome of the other forms of social activity; of the family system, the political system, the education system, the health system, and so forth. The subject of the line of research reported here in Section III is the impact of the economic arrangements of Soviet society on the Soviet family.

The number of outcomes of family activity in any society that are affected to some degree by economic arrangements is very large indeed. They include the rate of formation and dissolution of families, the child socialization process (including the process of human capital formation in the family), and the human reproduction process. This report deals with the last-named outcome. On the basis of the data gathered in the course of this project, a start has been made on the analysis of other outcomes of family activity but those lines of research are not yet sufficiently advanced to be reported on.

The analyst of Soviet fertility behavior is immediately struck by the wide regional differences. In general terms, differences in behavior may be explained by two sets of factors. One set consists of differences that are internal to people. In the language of sociology and anthropology
they are called culture or values. In the language of economics they are called tastes or preferences. The other set consists of external circumstances, which may be physical, like climate, or social, like income or class. People may therefore behave differently for one of three reasons; their tastes may be the same but their circumstances may differ; their circumstances may be the same but their tastes may differ; or both their tastes and their circumstances may differ.*

Fertility behavior in the USSR is characterized by dramatic differences among nationalities. Much of the difference is undoubtedly the consequence of culturally determined differences in tastes. But the various nationality groups also live under different social circumstances, and some portion of the difference in fertility may be explained by the differences in those circumstances. The purpose of this report is to assess the extent to which fertility differences may be explained by differences in social circumstances.

The question is important for at least four reasons. First the social conditions under which people live are to a great extent the consequences of past government policy. Hence the more we know about the relation between fertility and social conditions the better we can evaluate the success, or at least the influence, of government policy.

*For an elaboration of the relation between the concepts of culture and tastes, see Appendix J entitled "A Note on Sociological and Economic Explanation."
Second, the instruments of government policy are better equipped to change social conditions than to change tastes. Hence the greater the contribution of social conditions to fertility behavior, the greater the power of government to alter that behavior in the future in whatever direction the government deems desirable. Third, while we may know little about how tastes change over time, we can forecast roughly the likely changes in social conditions in the next decade or so. On the assumption that tastes change very slowly, we may be able to predict the changes in fertility behavior over that period of time.

The fourth reason is of more theoretical than practical interest. Differences in tastes are normally difficult or impossible to observe directly. Hence their influence is usually regarded as part of an unexplained residual. For example, that portion of differences in consumer behavior that cannot be explained by differences in external circumstances (i.e., income and prices in this case) is normally interpreted as reflecting differences in tastes. There is no independent basis for believing that the tastes of those consumers do in fact differ, other than that differences in their behavior persist even under putatively similar external circumstances. In culture, however, we have a strong independent basis for classifying people according to tastes, for if the concept of culture has any meaning at all, it must lie in the notion of acquired values and tastes. Hence in classifying people as Russians or Uzbeks, we can be fairly confident that they have been classified directly by taste differences, and we can be more secure in the judgement that such differences in behavior that remain when external circumstances are the same are the measure of the influence of taste differences.
Culture, in other words, is a valuable concept for studying the relative influence on behavior of tastes and of external circumstances. That question, indeed, became the focus of research as this project proceeded, and is one of the central questions in this report.

Parts II and III are the studies of the sources of the variation in fertility behavior in the USSR. In Part II, we analyze the variation among republics. The central question is the light that fertility variation among republics can shed on the influence of culture differences relative to that of such external circumstances as mother's education, urban or rural residence, per capita income, and so forth. In Part III the republics are divided into two groups, Moslem and non-Moslem. The central question is the extent to which cultural differences influence responses to differences in external circumstance. Part IV offers some concluding observations.

Part II. Nationality and Fertility

1. Introduction

Soviet governmental data are normally published by republic rather than by nationality, as in Table 1, col. 1. Since all the republics are multinational in various degrees, those data are imperfect measures of nationality differences. Special survey research studies do appear from time to time, however, in which the basis of classification is nationality, usually that of the mother. The results of one such study is presented in column 2 of Table 1. The study was based on a survey of 347 thousand married women conducted in 1972 by the Department of Demography of the USSR Central Statistical Administration (Belova, 1977).
Table 1. Fertility by Republic and Nationality, USSR, 1972-73

<table>
<thead>
<tr>
<th>Nationality or Republic</th>
<th>By Republic, Total Fertility Rate, 1972-73¹</th>
<th>By Nationality, Intended Fertility, 1972²</th>
<th>Indexes (Russia = 100)</th>
<th>Fertility of Low-Education, Rural Mothers (4)</th>
<th>Fertility of High Education, Urban Mothers (5)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(1)</td>
<td>(2)</td>
<td>Total Fertility Rate, 1972-73</td>
<td>Fertility of Low-Education, Rural Mothers</td>
<td>Fertility of High Education, Urban Mothers</td>
</tr>
<tr>
<td>Russian</td>
<td>2.02</td>
<td>2.00</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Ukrainian</td>
<td>2.08</td>
<td>2.08</td>
<td>103.0</td>
<td>82.7</td>
<td>99.9</td>
</tr>
<tr>
<td>Belorussian</td>
<td>2.28</td>
<td>2.31</td>
<td>112.9</td>
<td>94.1</td>
<td>108.4</td>
</tr>
<tr>
<td>Uzbek</td>
<td>5.67</td>
<td>6.26</td>
<td>280.7</td>
<td>172.0</td>
<td>131.7</td>
</tr>
<tr>
<td>Kazakh</td>
<td>3.32</td>
<td>5.01</td>
<td>164.4</td>
<td>137.7</td>
<td>116.5</td>
</tr>
<tr>
<td>Georgian</td>
<td>2.57</td>
<td>2.83</td>
<td>127.2</td>
<td>112.6</td>
<td>120.7</td>
</tr>
<tr>
<td>Azerbaidzhani</td>
<td>4.13</td>
<td>4.89</td>
<td>204.5</td>
<td>175.8</td>
<td>144.0</td>
</tr>
<tr>
<td>Lithuanian</td>
<td>2.42</td>
<td>2.23</td>
<td>119.8</td>
<td>92.1</td>
<td>155.9</td>
</tr>
<tr>
<td>Moldavian</td>
<td>2.63</td>
<td>2.62</td>
<td>130.2</td>
<td>117.1</td>
<td>101.6</td>
</tr>
<tr>
<td>Latvian</td>
<td>1.99</td>
<td>1.99</td>
<td>98.5</td>
<td>78.1</td>
<td>97.1</td>
</tr>
<tr>
<td>Kirghiz</td>
<td>4.89</td>
<td>6.04</td>
<td>242.1</td>
<td>149.8</td>
<td>121.0</td>
</tr>
<tr>
<td>Tadzhik</td>
<td>6.07</td>
<td>5.97</td>
<td>300.5</td>
<td>177.3</td>
<td>127.0</td>
</tr>
<tr>
<td>Armenian</td>
<td>3.07</td>
<td>3.42</td>
<td>152.0</td>
<td>159.3</td>
<td>148.2</td>
</tr>
<tr>
<td>Turkmen</td>
<td>5.87</td>
<td>5.93</td>
<td>290.6</td>
<td>166.4</td>
<td>128.2</td>
</tr>
<tr>
<td>Estonian</td>
<td>2.19</td>
<td>2.18</td>
<td>100.4</td>
<td>76.1</td>
<td>102.0</td>
</tr>
</tbody>
</table>

Unweighted mean          | 168.8                                       | 126.1                                    | 120.1                  |                                               |                                               |
Standard deviation        | 74.8                                        | 38.2                                     | .30                    |                                               |                                               |
Coefficient of variation  | .44                                         | .30                                      | .15                    |                                               |                                               |

Sources:  
Col. 1. Calculated from Vestnik Statistiki, 1974, No. 12, p. 88, Table 8.  
Col. 2. V. A. Belova et al., Skol'ko detei budet v sovetskoi sem'eye, Moscow, Statistika, 1977, p. 23.  
Col. 3. Derived from column (1).  
Cols. 4 and 5. From Appendix Table A.

Notes:  
1. The total fertility rate is the number of children a woman would bear in her lifetime if her fertility corresponded to the average age-specific fertility rates of women in the years 1972 and 1973.  
2. Intended fertility is the response to the question "How many children do you intend to have?"
The numbers however, represent intended rather than actual fertility; they are responses to the survey question, "how many children do you intend to have?"*

Both sets of data are deficient as measures of nationality differences in fertility. The republic data employ a good behavioral measure of fertility—the total fertility rate; but the republic is too heterogenous with respect to nationality composition. The nationality data are homogeneous in that respect, but they reflect expressed intentions rather than actual fertility behavior. There is little reason to expect, however, that a better set of data—a behavioral measure based on nationality—would tell a very different story. The rank order of nationalities might be slightly different, but the data would very likely be consistent with the general finding of sharp nationality differences in fertility.

Why these large differences in reproductive behavior? Most of the public discussion focuses on the differences in cultural values; Uzbeks presumably place a higher value on large families than Latvians. But Uzbeks differ from Latvians in respects other than culture. They differ in levels of income, in levels of education, in extent of urbanization and industrialization, and in other respects. Such differences in what may roughly be called social structure may also contribute to differences in reproductive behavior. The survey research study reported above found,

* Belova, 6-8. This question was asked of women aged 18-44. Women aged 45-59 were asked "How many (live) children did you bear?" on the assumption that the fertility of these women was completed.
for example, that in all nationalities rural women expected to have more children than urban (p.75), urban women in larger cities expected fewer children than urban women in smaller cities (p.75), women who married at age 20 or under expected more children than women who married between ages 21-29 (p.51), and so forth. The study examines the effect of a variety of other factors such as women's education and family income, but those results are not analyzed by nationality. Since Soviet published research rarely provides nationality data with two or more variables cross-classified, analysts can only examine the effect on nationality fertility differentials of one variable at a time.

Because of that limitation, the effect of cultural values on fertility may appear larger than it actually is. If urban Uzbeks have fewer children than rural Uzbeks and higher-education Uzbeks have fewer children than lower-education Uzbeks, then the difference in fertility between Uzbeks and others with the same residence and education characteristics would be smaller that that in columns (1) and (2) in Table 1. Columns (3)-(5) provide an indication of the magnitude of the effect of those two variables alone (education and residence.) Column (3) is an index of the republic-wide fertility rates in column (1). Column (4) is an index of the fertility of low-education, rural mothers.* Since the two indexes are derived from different measures of fertility, the difference between them is only suggestive of the order of the

*See charts 1 and 2 and Appendix Table A for the data in columns (4) and (5).
magnitude by which republic variation in fertility might decline when education and residence are held constant at the specific levels. In all republics except Armenia, the index numbers decline. The unweighted mean index declines from 168.8 to 126.1, and the coefficient of variation drops from .44 to .30, and decline of almost a third. Column (5) is an index of fertility of mothers at the other extreme of the social continuum; urban mothers with high education. The coefficient of variation for that group is down to .15, a drop of 66% from the republic-wide level of .44.* It is clear that a large portion of republic variation in fertility disappears when education and residence alone are controlled for. If in addition we could control for such other social characteristics as level of income, female labor participation and so forth, it is conceivable, in principle, that all differences among republics and among nationalities in Table 1 columns (1) and (2) would disappear, or even be reversed.

The 1970 Soviet Census of Population published a tabulation which offers an unusual opportunity to explore the joint effects on reproductive behavior of several variables of social structure. The tabulation presents a measure of fertility cross-classified by three variables: republic, mother's education level, and urban or rural residence. The data are

*Some of the decline may be due to the difference between the measures of fertility used in column (3) (total fertility rate) and that used in columns (4) and (5) (children per thousand mothers.) The effect of this difference is likely to be relatively small, however.
presented in Charts 1 and 2, and in Appendix Table A. Before proceeding to the analysis, however, it would be useful to describe and discuss the data.

2. The Data

The data are derived from a census enumeration of all Soviet mothers who had children living with them on the census date, January 15, 1970. The groups of mothers are homogeneous with respect to three characteristics; the republic in which they lived, the mother's education level, and urban or rural residence. Since there are fifteen republics, four education levels and two residence categories, the number of groups is 120 (i.e., $15 \times 4 \times 2$). For each group the mean fertility is recorded; the measure is "number of children per thousand mothers." The census does not define the term "children" but from the other publications it may be inferred that it refers to children who have not attained their sixteenth birthday.*

The census defines urban residents as living in localities that are legally defined as "cities or urban-type settlements." (TsSU, *Itozy* vol. 1, p.5). In the Russian republic a city is defined as a locality with at least 12,000 people and in which at least 85% of the population are families of workers or employees. An urban-type settlement is a locality with at least 3,000 people and in which at least 85% of the population...

*That is the definition given by the Central Statistical in other of its statistical complications, such as *Zhenshchiny v SSSR*, p. 92 and *Dety v SSSR*, p. 9.
CHART 2.  RURAL FERTILITY BY REPUBLIC

- TADZH.
- AZER.
- UZB.
- TURK.
- ARM.
- KIRG.
- KAZAKH.
- MOLD.
- GEORG.
- RUS.
- BEL.
- LITH.
- UKR.
- LATV.
- EST.

EDUCATION

Higher and Specialized Secondary
General Secondary
Incomplete Secondary
Elementary or less
population are families of workers and employers (Naselenie, p. 51).

The top of the four education levels is "higher and specialized secondary education" (ED4). It includes (a) those who have graduated from a specialized secondary school like a tekhnikum. The second level is called "general secondary education" (ED3). It includes graduates of a non-technical secondary school with a tenth or eleventh year of instruction. The third level, "incomplete secondary education" (ED2), includes (a) graduates of a middle-school,* and (b) those who attended one or more years of a secondary school but did not complete it. The lowest level is "primary education or less" (ED1). It includes (a) those who have completed the three years of primary school or less, and (b) those who have attended some years of middle school but had not graduated.

The number of mothers in each group is not published, but one would expect that the numbers vary greatly and that the Russian republic dominates the others. The census data, however, do permit an estimate of the number of women aged 20-54 in each observation group. The figures are presented in Appendix Table B and are summarized below by republic and residence:

<table>
<thead>
<tr>
<th></th>
<th>Urban</th>
<th>Rural</th>
</tr>
</thead>
<tbody>
<tr>
<td>Russia</td>
<td>60.7</td>
<td>47.9</td>
</tr>
<tr>
<td>Ukraine</td>
<td>19.4</td>
<td>22.9</td>
</tr>
<tr>
<td>Belorussia</td>
<td>3.0</td>
<td>5.0</td>
</tr>
<tr>
<td>Others</td>
<td>16.9</td>
<td>24.2</td>
</tr>
<tr>
<td>Total (percent)</td>
<td>100.0%</td>
<td>100.0%</td>
</tr>
<tr>
<td>Total (thous.)</td>
<td>35,787.3</td>
<td>22,262.6</td>
</tr>
</tbody>
</table>

* Before 1962 it was called a "seven-year school" (semiletka). After that it was extended to an eighth year (vos'miletka).
The Russian-republic women greatly dominate in numbers. The three largest Slavic republics together account for 83.1% and 75.8% of the urban and rural women respectively. These figures are probably a fair representation of the number of mothers in the original data, because (a) the overwhelming proportion of the mothers falls within the age brackets 20-54, and (b) while the proportion of women in those age brackets with no children at home is probably higher in the three Slavic than in the Moslem republics, it is probably lower than in the Baltic republics.

The educational distribution of the women in the those age brackets is:

<table>
<thead>
<tr>
<th></th>
<th>Urban</th>
<th>Rural</th>
</tr>
</thead>
<tbody>
<tr>
<td>ED4</td>
<td>26.6</td>
<td>15.9</td>
</tr>
<tr>
<td>ED3</td>
<td>21.4</td>
<td>8.7</td>
</tr>
<tr>
<td>ED2</td>
<td>29.0</td>
<td>27.7</td>
</tr>
<tr>
<td>ED1</td>
<td>23.0</td>
<td>47.7</td>
</tr>
<tr>
<td>Total</td>
<td>100%</td>
<td>100.0%</td>
</tr>
</tbody>
</table>

Somewhat surprising is the large proportion in the highest education category, ED4. It should be remembered, however, that the figures include not only graduates of higher education institutions but also those who completed more than half of a higher education program as a well as a large group of graduates of specialized secondary schools. If the fertility and economic behavior of those three sub-groups of women differs, as it well may, we are unfortunately not able to capture the difference in our analysis. The lowest education level (ED1) is similarly heterogeneous, ranging from women with virtually no schooling at all up to women who were one year short of completing middle school (i.e., up to 6-7 years of schooling.)
Because of the negative relation between education and fertility, the proportion of mothers with ED4 is probably smaller than the proportion of women with ED4, and the proportions of mothers with ED1 is probably larger than the proportion of women with ED1. However the extent of that differences is not likely to be large (a) because of the educational heterogeneity within ED4 and ED1, and (b) because the negative influence of education on fertility affects primarily the number of children a mother has, rather than the decision on whether to have any children at all. Hence the educational distribution of women is likely to reflect fairly well the educational distribution of the mothers in the census data.

As a basis for studying the reproductive behavior of Soviet women, the data are deficient in a number of respects. In some of those respects we have estimated adjustment factors; we have adjusted below, for example, for the difference in the average age of the mothers in the 120 observation groups. In other respects, however, we have not been able to adjust the data but have sought to interpret the results in the light of what we know or suspect to be the direction of the bias.

In the next section we analyze the original data, for a first view of their implications regarding the factors that influence fertility. In subsequent sections we examine the effects of various adjustments of data, and we study the influence on fertility of variables other than those reported in the original data.
3. **Aggregate Effects of Education, Residence and Republic**

Several broad tendencies are evident from inspection of Charts 1 and 2. In all republics and at all education levels, rural fertility exceeds urban. The effect of education is less uniform, however. While there is a broad tendency for fertility to decline as education increases, in some republics and at some education levels fertility appears to rise with income; and urban mothers sometimes differ from rural in these respects. The republic in which a mother lives also exerts a strong influence, but again it is not uniform. For both urban and rural mothers the lines sometimes cross. Urban mothers in Moldavia with primary education or less have slightly more children than the corresponding mothers in Georgia, but for all higher levels of education they have fewer.

While all three variables influence fertility systematically if not uniformly, the interesting question is the relative influence of the three. The question may be posed on the following way: to what extent is the difference in the mean fertility of these groups of mothers due to differences in their education level and their place of residence, rather than to the different characteristics of the republic in which they reside? To provide a basis for answering that question, the fertility data were regressed on those three variables. Each variable is represented as a "dummy" variable; two levels for residence—urban (URB) and rural (RUR), four levels for education, and fifteen levels for republic. The results are presented in Table 2. The regression coefficients are to be read as fertility differences between a given observation group and
the group that was selected as the base: namely, the group of rural women in the Russian Republic with elementary education or less (ED1). The regression constant, 2375.5, is the estimate of the fertility (average number of children per thousand mothers) in that base group. This estimate compares with the actual figure in Chart 1 of 2269 for that group. The coefficients in column 1 are the amounts by which fertility increases or decreases for mothers in the 119 other groups. Thus a mother who had completed higher education (ED4), and lived in a city (URB) in the Georgian republic had an estimated fertility of 2375.5 - 635.2 (for ED4) - 602.8 (for URB) + 365.1 (for Georgia) = 1502.6. This estimate compares with the actual figure in Chart 2 of 1862. \( R^2 \) is .894, signifying that 89% of the variation in the fertility data is explained statistically by the three sets of variables.

It should be noted that the \( R^2 \) applies not to the variation in fertility among Soviet mothers in general but to the variation among the means of the fertility rates of the 120 groups; that is to say, the regression equation in Table 2 provides a basis for predicting only the mean fertility of a sample of a thousand women randomly selected from a population of all Soviet women who share the same characteristics of republic, residence and education.* The variance among the women in the sample is not known. The \( R^2 \) in Table 2 is therefore not comparable to the \( R^2 \)'s normally found in cross-section data in which the dependent variable refers to individuals rather than to the means of groups of

*The data could be used for an analysis of the fertility of Soviet mothers by weighting the observations. Weighting could cause the Russian republic to dominate the results so heavily as to swamp the other republics. Moreover, our interest here is in understanding the variation among the observation groups, and not in projecting back to the Soviet population.
### Table 2. Aggregate Effects of Education, Residence and Republic on Fertility

<table>
<thead>
<tr>
<th>Independent Variables</th>
<th>Estimate (1)</th>
<th>t-ratio (2)</th>
<th>Type I SS (3)</th>
<th>Type IV SS (4)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Dependent Variable:</strong> Fertility (no. of children per 1,000 mothers) mean = 2268.1</td>
<td>Intercept: 2375.5</td>
<td></td>
<td>Percentage of Total Variation Explained</td>
<td></td>
</tr>
<tr>
<td><strong>1. Education:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. ED 4</td>
<td>-635.2</td>
<td>(-9.3)</td>
<td>6.7</td>
<td>9.1</td>
</tr>
<tr>
<td>b. ED 3</td>
<td>-496.5</td>
<td>(-7.3)</td>
<td>6.3</td>
<td>5.6</td>
</tr>
<tr>
<td>c. ED 2</td>
<td>-76.5</td>
<td>(-1.1)</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td><strong>Subtotal</strong></td>
<td></td>
<td><strong>13.1</strong></td>
<td></td>
</tr>
<tr>
<td><strong>2. Residence:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. URB</td>
<td>-602.8</td>
<td>(-12.6)</td>
<td>16.5</td>
<td>16.5</td>
</tr>
<tr>
<td><strong>3. Republic:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. Ukraine</td>
<td>-119.5</td>
<td>(-.9)</td>
<td>4.9</td>
<td>.1</td>
</tr>
<tr>
<td>b. Belorussia</td>
<td>69.5</td>
<td>(.5)</td>
<td>2.9</td>
<td>-</td>
</tr>
<tr>
<td>c. Uzbekistan</td>
<td>1179.8</td>
<td>(9.0)</td>
<td>4.8</td>
<td>8.4</td>
</tr>
<tr>
<td>d. Kazakhstan</td>
<td>588.6</td>
<td>(4.5)</td>
<td>.1</td>
<td>2.1</td>
</tr>
<tr>
<td>e. Georgia</td>
<td>365.1</td>
<td>(2.8)</td>
<td>.3</td>
<td>.8</td>
</tr>
<tr>
<td>f. Azerbaidzhan</td>
<td>1348.6</td>
<td>(10.3)</td>
<td>8.9</td>
<td>11.0</td>
</tr>
<tr>
<td>g. Lithuania</td>
<td>-35.1</td>
<td>(-.3)</td>
<td>3.1</td>
<td>-</td>
</tr>
<tr>
<td>h. Moldavia</td>
<td>86.8</td>
<td>(.7)</td>
<td>2.4</td>
<td>.1</td>
</tr>
<tr>
<td>i. Latvia</td>
<td>-217.5</td>
<td>(-1.7)</td>
<td>8.6</td>
<td>.3</td>
</tr>
<tr>
<td>j. Kirghizia</td>
<td>788.1</td>
<td>(6.0)</td>
<td>.1</td>
<td>3.7</td>
</tr>
<tr>
<td>k. Tadzhikistan</td>
<td>1158</td>
<td>(8.8)</td>
<td>3.5</td>
<td>8.1</td>
</tr>
<tr>
<td>l. Armenia</td>
<td>1117.9</td>
<td>(8.5)</td>
<td>5.1</td>
<td>7.5</td>
</tr>
<tr>
<td>m. Turkmenia</td>
<td>1281.6</td>
<td>(9.7)</td>
<td>15.0</td>
<td>9.9</td>
</tr>
<tr>
<td>n. Estonia</td>
<td>-171</td>
<td>(-1.3)</td>
<td>.2</td>
<td>.2</td>
</tr>
<tr>
<td></td>
<td><strong>Subtotal</strong></td>
<td></td>
<td><strong>59.9</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Total Explained Variation</strong></td>
<td></td>
<td></td>
<td><strong>89.5</strong></td>
<td><strong>89.5</strong></td>
</tr>
</tbody>
</table>
individuals; in the case of individual data the $R^2$'s are normally much smaller than the value of .89 in Table 2.

The figures in column (3) and (4) represent the percentages of the total variation in fertility accounted for by each of the variables in the order in which they enter the equation. ED4 alone accounts for 6.7% of the variation, and the education variable overall accounts for 13.1%. Urban residence accounts for 16.5%, and the republic variable overall accounts for about 60%.

Education and residence reflect the influence of social structure, in the sense that people who share the same culture may be expected to behave differently according to whether they live in a city or a village, or have more or less education. In those terms, these two variables of social structure account for about 30% of the variation in the fertility means of the 120 groups of mothers. It is very likely, however, that some portion of the 60% accounted for by republic is due to other variables of social structure, and the remainder by nationality-based differences in culture. As a preliminary statement, we may regard the figure of 60% as the upper limit of the influence of culture.*

*The effect of the multinational composition of the republics is to underestimate the influence of culture in republic-based data. This tends to offset the overstatement referred to above, but by an amount that is likely to be small relative to the degree of overstatement due to the omission of other social structure variables.
The foregoing analysis of the variation in fertility is based on measurement of the incremental sum of squares (Type I SS, in Table 2); that is, the amount by which the explained variation is increased as each variable is added in the order in which it appears in the Table. When the variables enter in a different order, the measures are somewhat different. Column (5), in Table 2 presents a different set of measures; the figures represent the amount by which the explained sum of squares increases if that variable enters last (Type IV SS). ED4, for example, accounts for 6.7% of the variation when it enters first, but 9.1% when it enters last.

The major effect of a change in the sequence of variables is to alter the relative explanatory power of the various levels of the multi-level variables (education and republic.) For example, when the order in which the education levels enter is ED2, ED3 and ED4, the Type I variation measures are 3.4%, 1.1% and 10.2%. Thus the explanatory power of ED2 rises from .1% when it enters as the third of the education levels, in Table 2 to 3.4% when it enters first. However, the results are reasonably stable in the two respects. First, ED4 continues to explain more of the variation due to education than the other two education variables. Second, the explanation power of the variable as a whole, including all levels, does not vary greatly with order of entry. When the order is ED2, ED3 and ED4, the total variation explained is 14.7%, compared to 13.1% in Table 2. The variation explained by the residence variable which has only one level (WRB) relative to the base-group level (RUR), remains 16.5% regardless of the order in which it enters. The type IV variation measures, broadly confirm the conclusion that order of entry influences the explanatory power of levels within the variable as a whole. They differ considerably from the incremental Type I measures, and while they are not strictly additive, the sums of their last-entered variation measures does not greatly differ from the sub-totals of the Type I measures. Moreover of the seven republics that rank in the upper
half of the fourteen * by order of the incremental sum of squares, five also rank in the upper half by order of Type IV sum of squares. Hence the figure of about 60% for republic variation and about 30% for education and residence are not greatly affected by order of entry.

The regression coefficients in column (1) measure the amount by which fertility varies from that of the base group for each variable separately. With respect to the republic variable, the six Moslem republics (Uzbek, Kazakh, Azerbaidzhan, Kirghiz, Tadzhik, Turkmen) and Armenia exhibit the largest differences in fertility relative to that in the Russian republic. A thousand mothers in the republic of Azerbaidzhan have 1348.6 more children than a thousand mothers in the Russian republic, while Kirghiz mothers have 788.1 more.** Armenia and the other

* There are fifteen republics, but since the Russian republic serves as the base, it has no coefficient value.

** When dummy variables are used instead of continuous variables, the regression coefficients are the differences between the means of sub-sets of observations. Hence the coefficient for Azerbaidzhan is simply the difference between the mean of the fertility measures of the eight Azerbaidzhan observations and the mean of the eight Russian observations.
three Moslem republics fall in between. All six estimates are statistically significant. Kazakhstan serves as a dividing line between Moslem and non-Moslem republics, with 589 more children than in Russia. The intermediate position of Kazakhstan is also evident in Charts 1 and 2. All the other republics are close to the Russian, ranging from Georgia, with 365 more children per thousand mothers, to Latvia, with 218 fewer.

The effect of education is concentrated at the two upper education levels. The fertility behavior of women with incomplete secondary education (ED2) differs very little from that of women with primary education or less; the coefficient of -76.5 is not statistically significant. The big impact comes with completed general secondary education (ED3). Movement to this educational level reduces the number of children per thousand women by 496.5; the coefficient is statistically significant. Movement to the highest education level (ED4) reduces the number of children by an additional 139, to 635.2 fewer than the low-education women; this coefficient is also highly significant. Nevertheless, the sharp break in fertility behavior occurs with the completion of secondary education. Educational attainments below that level have little effect in fertility. The data suggest that there is something about the completion of secondary education that is associated with a discontinuous drop in fertility. The drop is somewhat greater for those with specialized secondary or higher education (ED4) than for those with general secondary education (ED2) but these groups differ sharply from the primary and incomplete secondary groups.
Inspection of Charts 1 and 2, however, suggests that the apparently minor influence of the second level of education on fertility may be spurious. In the high-fertility republics, ED2 appears to reduce fertility among urban women (Chart 1) but to increase it among rural women (Chart 2). In the low-fertility republics, however, the effect of ED2 is mixed. The apparently small effect of ED2 in Table 2 may therefore reflect offsetting influences, each of which may be significant.

Finally, a thousand urban mothers have 602.8 fewer children than a thousand rural mothers; the coefficient is highly significant. The difference between the fertility of urban and rural mothers exceeds that between ED3 and ED1, but it is less than that between ED4 and ED1.

If the women in the 120 groups were homogeneous in all respects other than in the three variables, the results suggest that social structure, conveyed through the influence of residence and education, has a very large impact on fertility relative to that of republic. Rural mothers in Azerbaidzhan with low education (ED1) have 1348.6 more children than mothers in Russia with the same two social characteristics. But with higher education and urban residence, the fertility of mothers in Azerbaidzhan would be reduced by 1238 (i.e., 635.2 and -602.8) to a level only slightly above that of low-education rural mothers in Russia. In fact, the actual mean fertility of urban, high-education mothers in all the Moslem republics ranges between 2064 (Azerbaidzhan) and 1670 (Kazakhstan), in all cases lower than that of the level of 2269 for rural, low-education mothers in Russia (Charts 1 and 2). Social structural influences appear to be as powerful as the influence of republic in those republics in which the latter is greatest (Azerbaidzhan), and more powerful in those republics in which it is weaker.
Since a relatively large proportion of the urban, high-education mothers in the Moslem republics are not Moslems, these results reflect both cultural and social structural differences, but the latter clearly exert a strong influence on fertility.

4. The Effect of Mother's Age

The mothers in the 120 observation groups are homogeneous with respect to the three independent variables, but they are heterogeneous in a variety of other respects. One such respect is age. A priori, one would expect the following differences:

1. Mothers with primary education or less (ED1) are likely to be older than the average because the women's educational level has been rising.

2. Mothers with higher education (ED4) are likely to be older than average because of the additional years of schooling they experience.

3. Rural mothers are likely to be older than urban because rural migrants to the city tend to be younger than average.

If the average age of the observation groups varies greatly, it will affect our analysis, because some families will be closer to having completed their fertility than others. To adjust for age difference, we first constructed a set of estimates of the average age of each group. Since age-distribution data for mothers are not available, we have used instead age-distribution data for women aged 20-54, as in the
case of the education-distribution data in Appendix Table B. The data in that Table, are drawn from a source in which age is presented in 10-year intervals. Using the mid-points of the age intervals, the weighted-average age of each group was calculated, with the results presented in Appendix Table C.

As expected, the relation between age and education is U-shaped. The lowest-education women are the oldest. Average age then declines fairly sharply with rising education until the highest-education level, when age rises again. The U-shape is consistent with the first two hypotheses offered above.

The third of those hypotheses is also sustained. The weighted average age of all urban women aged 20-54 is indeed lower than that of all rural women in all but four republics, all of them Moslem: Uzbekistan, Azerbaidzhan, Tadzhikistan and Turkmenia. Those exceptions prove the rule, for we would expect that female rural-to-urban mobility is relatively low in the Moslem republics; hence the rural-urban age difference observed elsewhere should be less pronounced or even absent. However, when women are classified by education level, it turns out that without exception urban women at a given education level are older than rural women with the same education. Such a difference between the behavior of wholes and the behavior of their parts requires an explanation.

Mathematically, there is no inconsistency. The average-age figures for the Russian republic, for example, are:
The urban ages are all larger than the rural, but the weighted urban average is lower than rural. That result is simply the consequence of differences in weights; there are relatively more rural women in the lower-education-higher age groups, ED2 and ED1. The question is, what kind of social process might have produced that difference in weights?

Two such processes may be identified; they may be called the education-expansion process and the migration process. The education-expansion process refers to the historic process of the expansion of women’s education first in the urban areas and later in the rural. Hence at any education level the first women to have attained that level were urban; i.e., the older women at each education level are likely to be urban rather than rural. Hence the higher average age of urban women at each education level.

The migration process refers to the fact that young migrant women acquire more education in the city than they would have acquired had they remained in the village. The typical migrant woman, had she not migrated, would have been among the younger women in her education range and at the upper education level of that education range; for instance one of the better educated and younger of the ED1 level. Perhaps she would have attended one or two years of the middle school but not completed it.
After migration, however, she would reappear at the lower range of the next higher education level, as one of the older women in that level; for instance as one of the less educated but older women at the ED2 level. She may have just completed the middle school, which is the minimal attainment at ED2, and she will be older than most ED2's because women's education level has been rising.

The total migration process may then be separated into an age effect and an education effect. As a result of the age effect of migration the average age of urban women is lower than that of rural women. But as a result of the education effect, the urban women are redistributed among education levels in such fashion as to cause the average age at each level to rise.*

The average-age estimates of women aged 20-54 are therefore consistent with expectations. We have no way of estimating the ratio of "mothers with children" to "all women aged 20-54" in each group. The negative relation between education and fertility suggests that the ratio is lower for the higher-education levels. But that negative relation applies primarily to numbers of children; i.e., whether to have a second or third

*Since the average age of the highest-education level (ED4) is higher that that of the next lower, the education effect would tend to lower the average age there. That consequence is offset, however, by the prolonged education at their level; women do not complete higher education beyond ages 23-25.
child. It applies with less force to such decisions as whether to marry and whether to have a first child. We may therefore use the data in Appendix Table C on women aged 20-54 as an estimate of the average age of mothers with children.

Given the average age of the mothers, what is next required is the relation between mothers' age and number of children at home. The census does provide a tabulation of number of children per family by age of mother and by republic and residence. Unfortunately no further disaggregation by level of education is available. The weighted average number of children by age of mother, derived from that tabulation, is presented in Appendix Table D.

In all age intervals, the number of children at home varies greatly by republic, and the rural number invariably exceeds the urban. For our purposes the important finding is that in all cases the largest number of children at home occurs when the mother is aged 35-39. Presumably beyond that age interval the number of children who attain the age of sixteen exceed the number of newborn. Fertility is evidently largely completed during that interval. We therefore take age 37, the mid-point of the 35-39 age interval, as the age at which to standardize the fertility data.

The standardization was carried by linear interpolation. For example, the average age of urban, ED4 mothers in the Russian Republic was estimated to be 34.4 years (Table C). From Table D we see that the mean number of children for women aged 32 (mid-point of the 30-34 age interval) was 1.64, and the mean number of children for women aged 37 (mid-point of the 35-39 age interval) was 1.84. Interpolating, the
mean number of children for women aged 34.4 was 1.74. The maximum number of children these women will have at home (1.84 children, when they are 37) is 1.06 times the estimated number they now have (1.74) at their estimated present age of 34.4. The figure of 1.06 is the age-adjustment factor. Appendix E presents the estimated age-adjustment factors for the 120 observation groups. The adjustment factors are generally somewhat larger for the urban than for rural mothers. That may see to be inconsistent with the finding in Table C that urban mothers are older than rural mothers in the same age intervals. Older women are presumably closer to the age at which fertility is completed. Their present number of children, it would seem, should therefore be adjusted upward by less than in the case of the younger rural women in the corresponding ages.

The observed results could be the consequence of the later age at which urban women bear their first children. In Table D it may be noted that in urban Russia the average number of children rises by .20, or 10.9%, between ages 30-34 and 35-39 (i.e., from 1.64 to 1.84). In rural Russia, however, the corresponding figure is .18, or 7.4%. That pattern is without exception for all republics: the urban rise during those ages is greater than the rural, both absolutely and relatively. The change in number of children under 16 during those years is the result of two factors: (1) additional births, which raises the number of children at home, and (2) the number of children turning sixteen and thus decreasing the number of children at home. If rural women begin having children earlier than urban women,
then their oldest children will turn sixteen when the mother is younger than in the case of urban women. Hence the (net) number of under-sixteen children at home will rise more slowly during those ages for rural mothers, as the data show; rural women aged 30-34 are closer to their maximum number of children at home than are urban women in that age interval. Therefore the rural age-adjustment factors in Table E are smaller than the urban.

Unfortunately, the age-fertility data in Table D cannot be disaggregated by education level of mother. Hence the relation between age of mother and number of children at home implied in that Table had to be applied to all your education levels in a given republic and place of residence. Since low-education mothers have their first child at a younger age than high-education mothers, one would expect that the age at which the largest number of under-sixteen children are at home would be lower for the former. The oldest children of low-education mothers will have begun to turn sixteen at an age when the mother was younger, than in the case of higher-education mothers. Hence low-education mothers will have their largest number of children at home at an age lower than the average age of 37, while higher education women will have their maximum at an age greater than 37. It follows that by standardizing at age 37, we are likely to have underadjusted for higher-education mothers and overadjusted for lower-education mothers. While we can identify the direction of the distortion, we can offer no judgement about its magnitude.
Appendix Table F, finally, presents the age-adjusted fertility rates, obtained by multiplying the original fertility data by the age-adjustment factors in Table E. It may be taken to represent the number of children that a thousand mothers in each of the 120 observation groups would have when their average age reached the standardized age of 37 years, which we take as an approximate measure of completed fertility. The effect of the adjustment may be seen in Table 3, which presents the results of the regression of the three variables on the adjusted fertility data.

The principal effect of the age adjustment is to reduce slightly the influence of the social structural variables and to increase that of the republic variable. Education declines from 13.1% to 12.1% and residence from 16.5% to 15.5%. Republic increases from 59.9% to 62.3%. Hence the age adjustment does not change the broad conclusion that republic accounts for about 60% of the variation in fertility and education and residence about half of that.

It is possible that the deficiencies in our estimates of the age-adjustment factor may explain the insensitivity of the results to the adjustments. If data were available for mothers, instead of all women aged 20-54, and if the relation between mother's age and number of children could be disaggregated by mother's education level, it is possible that the improved age adjustments would produce greater changes in the data. But it is doubtful that the difference would be larger even in that case. Therefore, in view of the deficiencies in the age adjustment factors and the likelihood that more precise estimates would not change the results greatly, we shall continue to use the unadjusted data in what follows.
Table 3. Aggregate Effects of Education, Residence and Republic on Age-Adjusted Fertility

Dependent Variable: Adjusted Fertility (No. of children per 1,000 mothers)
Mean = 2397.2; Intercept: 2462.3

<table>
<thead>
<tr>
<th>Independent Variables:</th>
<th>Estimate (1)</th>
<th>(t-ratio) (2)</th>
<th>Percentage of Total Variation Explained</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Type I SS (3)</td>
<td>Type IV SS (5)</td>
<td></td>
</tr>
<tr>
<td>1. Education:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. ED 4</td>
<td>-645.1</td>
<td>-9.92</td>
<td>8.4</td>
</tr>
<tr>
<td>b. ED 3</td>
<td>-381.1</td>
<td>-5.80</td>
<td>3.5</td>
</tr>
<tr>
<td>c. ED 2</td>
<td>-95.0</td>
<td>-1.46</td>
<td>0.2</td>
</tr>
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<td>Subtotal</td>
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<td></td>
<td>12.1</td>
</tr>
<tr>
<td>2. Residence:</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>a. URB</td>
<td>-571.0</td>
<td>-12.42</td>
<td>15.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>15.5</td>
</tr>
<tr>
<td>3. Republic:</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>a. Ukraine</td>
<td>-137.2</td>
<td>-1.09</td>
<td>5.5</td>
</tr>
<tr>
<td>b. Belorussia</td>
<td>90.9</td>
<td>0.72</td>
<td>2.8</td>
</tr>
<tr>
<td>c. Uzbekistan</td>
<td>1,201.9</td>
<td>9.54</td>
<td>5.3</td>
</tr>
<tr>
<td>d. Kazakhstan</td>
<td>610.7</td>
<td>4.85</td>
<td>0.1</td>
</tr>
<tr>
<td>e. Georgia</td>
<td>285.4</td>
<td>2.27</td>
<td>0.8</td>
</tr>
<tr>
<td>f. Azerbaidslian</td>
<td>1,280.5</td>
<td>10.17</td>
<td>7.6</td>
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<tr>
<td>g. Lithuania</td>
<td>15.1</td>
<td>0.12</td>
<td>2.9</td>
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<tr>
<td>h. Moldavia</td>
<td>142.2</td>
<td>1.13</td>
<td>2.1</td>
</tr>
<tr>
<td>i. Latvia</td>
<td>-276.5</td>
<td>-2.20</td>
<td>10.7</td>
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<td>j. Kirghizia</td>
<td>808.1</td>
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<td>0.1</td>
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<td>k. Tadshikistan</td>
<td>1,188.2</td>
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<td>3.8</td>
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<td>l. Armenia</td>
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<td>m. Turkmenia</td>
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<td>16.5</td>
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<td>n. Estonia</td>
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<td>0.87</td>
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<td>Subtotal</td>
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<td></td>
<td>62.3</td>
</tr>
<tr>
<td>Total Explained Variation</td>
<td>99.9</td>
<td></td>
<td>89.9</td>
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Of the total variation in the fertility of the observation groups, we have found, about 30% is explained by differences in the two variables of social structure—mother's residence and education. Republic differences account for twice that amount, or about 60%. Why is it that women who live in different republics have different numbers of children, even after residence and education are controlled for?

Part of the answer is surely to be found in the cultural differences among republics. But the question is, how much? Can the full 60% be explained by cultural differences? Or is part of the 60% due to features of social structure other than residence and education?

In this section we test for two additional features of social structure that may account for part of the variation. But it is appropriate at this point to elaborate on the distinction drawn here between culture and social structure. The distinction is not a sharp one. As used here, the term culture applies to values, and corresponds to what are referred to as "tastes" in economic analysis. They may be thought of as properties internal to persons—psychological properties like consciousness or preferences. Social structure refers to circumstances external to an individual that influence behavior, like living in a city, or being over fifty years old, or having a high income. The concept of an "income constraint" in economic analysis is a characteristic of social structure. The general paradigm is that people who hold the same cultural values behave differently if they occupy different
positions in the social structure. People who hold the same cultural values are constrained to behave differently if they are married or unmarried, or if they have high or low incomes.

As applied to the subject of this paper, the difference between culture and social structure is blurred because the position a person occupies in the social structure is not independent of his values. Participating in the labor force constrains the fertility of mothers in certain ways, and if more non-Moslem than Moslem women participate in the labor force, one may assert that to a certain extent nationality fertility differences are due to differences in social structure rather than culture. The difficulty, however, is that cultural values are involved in the decision on whether to participate in the labor force. Nevertheless the difference between culture and (tastes) as internal properties, and social structure (and constraints) as external properties is worth preserving. In the discussion to follow, variation in fertility due to such variables as mother's education will be regarded as evidence of the influence of social structure, even though the prior decision to attain that level of education was partially influenced by culture. That is to say, when culture influences behavior indirectly, through its effect on a person's location in "social space," the behavior will be regarded as a response to social structure. Culture, or "pure" culture, will be regarded as influencing behavior only when that influence is direct.

In this section we test the effect on fertility of three social variables, each of them based on a hypothesis regarding its effect on
fertility (See Appendix Table H for the values):

1. Rurality of the republic. The census variable URB identifies the group of mothers as living in cities or "urban-type settlements." The population of the latter can be as small as 3000. A variable that broad is unlikely to discriminate very much among the ways in which urban residence influences fertility behavior.

Why should living in a city cause women to have fewer children than living in a village? Presumably the answer has something to do with the differences between the costs and the benefits of having children in the two kinds of residence. Residence is thus a proxy for a whole set of factors that influence fertility decisions.

We would expect that those factors operate with different force in cities of different sizes, as the published data indeed show.* Ideally we would like to decompose the variable URB into several levels by size of urban residence, like the education variable in the census data, but the data are not available. We can, however, test a somewhat different effect of urban residence. Kharchev and Matskovskii (1978, p. 184) remark that in small cities and even in villages located near large administrative centers, reproductive behavior and the social conditions that influence it are similar to those in the administrative centers. Pursuing that point, we may expect that the social conditions of

women classified as rural differ according to what may be called the "rurality" of their social environment. There is a sense in which a rural woman in a rural republic like Uzbekistan is more "rural" than a rural woman in an urbanized republic like Latvia. Specifically, the costs and benefits of children relative to other goods for a Latvian rural woman are likely to be more similar to those confronting an urban woman than would be the case for an Uzbek rural woman. Or otherwise put, the more urbanized a republic becomes, the more the fertility of its rural women approaches that of its urban women. To test this proposition, we introduced a measure of the percentage of the employed population engaged in agriculture in the republic in 1970 (A70)*. We expect the sign of the coefficient to be positive.

The relationship of A70 to URB may be thought of as that between macroresidence and microresidence. URB reflects the social conditions of the immediate neighborhood—the microresidence—which ranges from a small village to a large city, A70 reflects the social conditions of the republic—or macroresidence—in which the city or village is located. Hence we expect, for example, that if two groups of mothers both lived in urban microresidences, other things equal their fertility should be the same. But if the first macroresidence were situated in a highly rural macroresidence while the second were in a highly urban one, we would expect the fertility to be higher in the first. Thus A70 should compensate in part for the deficiencies of the dichotomous variable URB

* Data from the 1970 Census, vol. p. 29. We also tested two other measures of rurality: (1) percent of employed population engaged in agriculture in 1959, on the assumption that the number of children per mother in 1970 reflects the social structure of an earlier year, and (2) percentage of the republic's population living in rural settlements in 1970, from Feshbach and Rapawy (1976) p. 127. A70 had the largest explanatory power.
as a measure of the relative costs and benefits of children insofar as the costs and benefits are influenced by place of residence.

2. The republics differ, second, in respect to per capita income. In accordance with the usual assumption that children are a normal good, fertility should increase with income. However, republic per capita income is also positively correlated with the republic female labor participation rate ($r=.42$; see Table 4, Correlation Matrix). To the extent that the latter is also positively related to women's wage rates, the high-income republics are likely to be those with higher women's wage rates, which depresses fertility, assuming that in the USSR as elsewhere the negative substitution effect exceeds the positive income effect of higher women's wages. Since wives' income is a larger share of family income in the USSR than in Western countries, we expect the substitution effect to be larger in the USSR than in the West. The coefficient of per capita income (YGIL) should therefore be negative.

The data on republic per capita income in 1966 are those estimated by Gillula (1979, p. 627).

3. As an alternative to per capita income, we tested the 1970 republic per capita consumption data recently developed by Mac Auley (1979, p. 109). The consumption data (YMAC) are highly correlated with the income data ($r=.97$), and there is little to choose between them a priori. In the absence of extensive opportunities for private investment in capital, either physical or human, one would expect the correlation to be very high. Since the income data refer to the year 1966, while the consumption data refer to 1970, we might expect the former to reflect somewhat more accurately the effect of level of living during
the period when the fertility decisions revealed in our 1970 data were being made. However, the inclusion of the time lag did not increase the explanatory power of the rurality variable; the 1970 rural population percentage explained more than the corresponding figure for 1959.

In the regressions the consumption data yielded higher $R^2$'s, and we therefore use it in the discussion below as a proxy for republic per capita income.

The results of the regressions are reported in Table 4. Education and residence alone (Model I) account for 30% of the variation, as reported above. The addition of the republic percentage engaged in Agriculture (A70) adds 11.8 percentage points to the explained variation (Model II), raising $R^2$ to .41. The coefficient is positive and significant; a one-percent increase in the percentage of the republic engaged in agriculture increases the number of children per thousand mothers in that republic by 25.5, or by about 1% of the mean. Hence the result apparently sustains the hypothesis that the more rural the macroresidence, the lower the fertility of mothers in the same microresidential circumstances. Moreover the simple correlation coefficient of fertility (FERT) on A70 is also positive ($r=.39$. See the Correlation Matrix in Table 4.)

However, when the other variables are included, the sign of A70 reverses and the hypothesis is not sustained. When the per capita income of the republic (YMAC) is included, for example, as in Model III, the sign of the coefficient of A70 becomes negative. The explanation lies in the strong negative relation between A70 and YMAC ($r=-.73$); because
Table 4. SOURCES OF VARIATION IN FERTILITY

<table>
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<tr>
<th></th>
<th>R²</th>
<th>Intercept</th>
<th>Education (ED4)</th>
<th>Education (ED1)</th>
<th>Education (ED2)</th>
<th>Residence (UR8)</th>
<th>Percentage in Agriculture (A70)</th>
<th>Per Capita Income (YMAC)</th>
<th>Percentage of Moslems (MOSPCT)</th>
<th>Female Labor Participation Rate (FLPPR)</th>
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<tr>
<td><strong>Model I</strong></td>
<td>.30</td>
<td>2871.5</td>
<td>6.7</td>
<td>6.3</td>
<td>0.1</td>
<td>13.1</td>
<td>16.5</td>
<td>11.8</td>
<td>30.9</td>
<td>13.3</td>
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<tr>
<td>Percentage of variation*</td>
<td></td>
<td></td>
<td>(9.1)</td>
<td>(5.6)</td>
<td>(0)</td>
<td>(16.5)</td>
<td>(11.8)</td>
<td>(30.9)</td>
<td>(13.3)</td>
<td>(17.7)</td>
</tr>
<tr>
<td>Coefficient**</td>
<td></td>
<td></td>
<td>-635.2</td>
<td>-469.5</td>
<td>-76.5</td>
<td>-602.8</td>
<td>(-5.2)</td>
<td>(-5.2)</td>
<td>(-5.2)</td>
<td>(-5.2)</td>
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<tr>
<td><strong>Model II</strong></td>
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<td>6.7</td>
<td>6.3</td>
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<td>16.5</td>
<td>11.8</td>
<td>30.9</td>
<td>13.3</td>
</tr>
<tr>
<td>Percentage of variation</td>
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<td></td>
<td>(9.1)</td>
<td>(5.6)</td>
<td>(0)</td>
<td>(16.5)</td>
<td>(11.8)</td>
<td>(30.9)</td>
<td>(13.3)</td>
<td>(17.7)</td>
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<tr>
<td>Coefficient</td>
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<td>-469.5</td>
<td>-76.5</td>
<td>-602.8</td>
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<td>11.8</td>
<td>30.9</td>
<td>13.3</td>
</tr>
<tr>
<td>Percentage of variation</td>
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<td></td>
<td>(9.1)</td>
<td>(5.6)</td>
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<td>(11.8)</td>
<td>(30.9)</td>
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<tr>
<td>Coefficient</td>
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<td><strong>Model IV</strong></td>
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<td>0.1</td>
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<tr>
<td>Percentage of variation</td>
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<td>(30.9)</td>
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<tr>
<td>Coefficient</td>
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<td>-76.5</td>
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<tr>
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<td>(5.6)</td>
<td>(0)</td>
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<td>(11.8)</td>
<td>(30.9)</td>
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<tr>
<td>Coefficient</td>
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<tr>
<td>Percentage of variation</td>
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<td>(5.6)</td>
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<td>(11.8)</td>
<td>(30.9)</td>
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<tr>
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<td><strong>Model VII</strong></td>
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<td>4842.1</td>
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<td>6.3</td>
<td>0.1</td>
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Correlation Matrix

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<th>FERT</th>
<th>A70</th>
<th>YMAC</th>
<th>MOSPCT</th>
<th>FLPPR</th>
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<td>FERT</td>
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<td>-.17</td>
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<td>A70</td>
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<td>YMAC</td>
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<td>MOSPCT</td>
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<td>FLPPR</td>
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</tbody>
</table>

Notes: *The percentage reported is based on the Incremental sum of squares (Type I SS).
The percentage in parenthesis is the last-entered sum of squares (Type IV SS).
**Figures in parentheses are t-values.
of that relation the coefficient estimate of A70 is biased when YMAC is not controlled for.

It is possible that the positive sign of A70 in Model III does correctly describe Soviet fertility behavior, contrary to our hypothesis. But it would be premature to accept that proposition or indeed to foreclose the possibility that the hypothesis may be valid even if not sustained by our results. For one thing, the variable A70 is a very crude measure of macroresidence. It is a measure of the percentage engaged in agriculture in a given republic, and therefore all of the eight observation groups in each republic are assigned the same value of A70. For a stronger test of the hypothesis, one would prefer a measure that discriminated more finely; for example, between the macroresidences of high-education urban mothers and low-education rural mothers in the same republic.

Per capita income (YMAC) proves to be the most powerful explanatory variable we have encountered thus far. It accounts for 30.9% of the variation, even when it enters last as in Model III. Its explanatory power in equal to that of education and residence combined (29.6%). The coefficient estimate is highly significant and the sign is negative, which is consistent with the hypothesis that the substitution effect of women's wages is very large. Each percentage-point increase in the per-capita income of a republic reduces the number of children per thousand mothers by 33.9, or by 1.5% of the mean (2268.1). Fertility is therefore negatively elastic with respect to republic income.
The YMAC data, like the A70 data, are deficient because they also refer to the republic as a whole. Hence while YMAC captures the effect of inter-republic income differences, it fails to reflect the effect of the sizeable income differences among the eight observation groups within each republic. Hence low-income rural mothers in Russia are represented as having a higher per capita income (107.9; USSR=100) than high-education urban mothers in Georgia (89.7). Reference to Georgia, moreover, reminds one of the uncertainty of all Soviet income and consumption estimates because of the difficulty of taking account of incomes earned in the second economy. The effect of YMAC must therefore be taken as a very rough approximation.

The four variables of social structure in Model III (ED, URB, A70, YMAC) explain 72 percent of the variation in fertility. This compares with the 90% (Table II) that is explained when the identity of the republics is known. The two figures testify to the powerful influence of social structure in the explanation of fertility. That is, without knowing the republic or the nationality of the homogenous groups of mothers, but knowing only two characteristics of the social structure of their republics, we can come within 18 percentage points of the variation we could explain if we knew the identity of the republic alone. It is clear that a very large part of the influence of republic on fertility is transmitted through social structure.
6. Nationality and Female Labor Participation

The cultural difference that dominates Soviet society is that between Moslems and non-Moslems. There are also cultural differences among Moslems and among non-Moslems that must influence tastes regarding children. But those differences are minor, compared to that which distinguishes Moslems from all others.

The general view is that Moslems place a higher value on large numbers of children than do non-Moslems. Presumably that assertion must carry the caeteris paribus proviso. In terms of our data, it should mean that the larger the percentage of Moslems within each of our observation groups, the larger the number of children that group of women will have, other things equal. In this case, residence and education are equal because of the way the mothers are initially classified; and macroresidence and income are equal by virtue of the data we have added. What is required is a set of measures of the percentage of Moslems.

Our estimates are presented in Appendix Table G. The basic data used for the estimates are census tabulations of the ethnic composition of the republics and the educational distribution of ethnic groups. However all the data on all the smaller ethnic groups are not always available, and a variety of approximations had to be made. The details of the estimates are presented in the Annex to Table G. Since there were no data on mothers, we again had to resort to the data on women, and since the educational-distribution data referred to women over 11, our estimates also apply to women over 11. Thus the estimates are in error to the extent that the education and
and residential distribution of mothers differs from that of women 11 and over. In the absence of independent evidence on the question, we must regard the figures in Table G as very crude approximations of the percentage of Moslems (MOSPCT) in each of our 120 groups of mothers.

The result of the addition of MOSPCT to the regression equation are presented in Table 4, Model IV. MOSPCT adds 13.3% to the explained variation bringing the $R^2$ up to .86. This compares with the $R^2$ of .895 in Table 2. Thus the three variables A70, YMAC and MOSPCT carry an explanatory power virtually equal to that of the identity of the republic in which the mothers reside. Or otherwise put, the three variables provide virtually the full explanation of that portion of the variation in fertility due to republic of residence.

To the extent that MOSPCT conveys the direct effect of culture on fertility, the results imply that it is relatively small. Both in terms of the proportion of variation explained and in the size of the regression coefficient, its influence is of the same order as that of macroresidence (A70) and less than that of per capita income (YMAC). But, as set forth earlier, culture can also influence fertility indirectly, through its effect on social structure. That influence is suggested by the simple correlation of MOSPCT with macroresidence (.39) and with income (-.67) (see Correlation Matrix on Table 4). If we exclude those two social structural variables from the regression, as in Model V, the influence of MOSPCT turns out to be exceeding high accounting for 51.7% of the variation in fertility. This compares with the 59.9% that is explained by republic of residence in Table 4.
That is to say, if we know only the percentage of Moslems among the 120 groups of mothers but did not know their republic of residence, we could explain almost as much of the fertility variation (81%) as if we knew their republics (89.5%). Additional information about their macroresidence and the per capita income of their republic would raise the explanatory power to 87%.

The indirect influence of culture, however, is larger than the 51.7% in Model V. To the extent that the culture also influences the choice of mother's attained education level and the decision to live in a city or a village, some portion of the variation in fertility accounted for by ED and URB represents the indirect effect of culture. Indeed the simple correlation between FERT and MOSPCT is .82, implying that 67% of the variation in fertility is accounted for by MOSPCT alone.

Before drawing the threads together, notice must be taken of the influence of female labor force participation (FLFPR) on fertility. Some analysts exclude FLFPR as an independent variable because it is so highly correlated with fertility. In fact, it could be argued, the choice of whether or not to participate in the labor force is part of the same decision-making process as the choice of whether or not to have a child; to choose to have a child is to choose to withdraw from the labor force. If that indeed is the behavior to be modelled, then FLFPR should not be regarded as a variable independent of fertility.

Many analysts, however, regard the two choices as being much less interdependent than portrayed above while they are related to some degree, each one is influenced by a variety of other factors, such as the woman's wage rate, the husband's income and so forth. Hence FLFPR is included in the fertility equation. The question of the direction
of causation is also a point of dispute. Recent practice is to employ a simultaneous-equation model in which each appears as an explanatory in the equation of the other (Fleisher and Rhodes, 1979; Gregory, Campbell and Cheng, 1972).

In the Soviet case, it can be argued that the decision runs primarily from the fertility choice to the labor participation choice. That is to say, women normally expect to be in the labor force, but drop out for a time after having decided to have a child. Nevertheless, there are contexts in which the causation runs the other way. The relative unavailability of "women's jobs" in a region may lead to a lower rate of female labor participation, which in turn decreases the cost of having a child. In this context the fertility decision is dependent on labor force participation.

In future work we intend to develop a simultaneous-equation model to capture the interdependence of the two variables. For the present, however, we test the effect of treating labor force participation as independent. Our estimates are presented in Appendix Table I.

The simple correlation between fertility and female labor participation is .30, smaller than that between fertility and all the other variables we have added to the original data. That relatively low correlation suggests that, in the Soviet context at least, fertility and labor force participation are only moderately interdependent, and both are heavily influenced by other factors.

When FLFPR is the only variable added to the equation, as in Model VI, it accounts for 22.9% of the variation. That compares with the 51.7% accounted for by MOSPCT when it serves as the only variable
added (Model V). Part of that difference is due to the smaller variance of FLFPR, which is a consequence of the generally high labor participation of Soviet women. Its coefficient of variation is only 13%, compared to 131% for MOSPCT. Given that relatively small variance, the fact that its explanatory power (22.9% of the variation in fertility) is almost half that of MOSPCT (51.7%) testifies to the heavy influence it exerts on fertility.

When FLFPR is the last variable included in the full equation (Model VII), its explanatory power becomes very small, falling to 1.3% of the variation.* The other variables with which it is partially correlated pick up most of the variation that would otherwise be ascribed to FLFPR. The coefficient, however, remains fairly high, equal (and opposite to) that of MOSPCT; a one-percent increase in female labor participation decreases the number of children per thousand mothers by 12.6, while a one-percent increase in the proportion of Moslems increases it by 12.0 children.

The introduction of FLFPR, however, changes the degree of influence of other variables in ways that offer important insights into the fertility data in Charts 1 and 2. In Models I-V the regression coefficient of ED4 is larger than that of ED3, and the coefficient of ED2 is small and

*If the order of FLFPR and MOSPCT are reversed in Model VII, the variation explained is virtually unaffected. FLFPR changes from 1.3% to 1.1% and MOSPCT changes from 13.3% to 13.5%.
not significant statistically. With FLFPR in the model (Models VI and VII), however, the coefficient of ED3 becomes larger than that of ED4—very much larger in Model VII. What that result says, in effect, is that when labor force participation is held constant, mothers with higher education (ED4) have more children (the coefficient is less negative) than mothers with only general secondary education ED3. Or otherwise put, the reason that ED4 mothers in fact have fewer children (Charts I and II) than ED3 mothers is not that they love children less but that they participate more in the labor force. That inversion occurs even when percentage of Moslems is also held constant (Model VII). It is evident that the factors that influence the differential labor participation of women has an important effect on differential fertility.

In a similar vein, in all the models that ignore FLFPR (Models I-V), the coefficient of ED2 (incomplete secondary education) is small and is not statistically significant. But when labor force participation is controlled for (Models VI and VII) the coefficient of ED2 becomes both statistically significant and very much larger—even exceeding that of ED4 in Model VI. What that result says is that while ED2 mothers (same secondary education) have about the same number of children as ED1 (no secondary education) mothers (Charts I and II), the reason is that they participate in the labor force to a much smaller degree. When labor participation is held constant, those extra years of education prove to have a very strong negative effect on fertility.
The foregoing results suggest that female labor participation is sufficiently independent of fertility, in the Soviet context at least, to warrant the treatment of it as an independent variable.

In concluding, we return to a methodological caution introduced earlier -- that our findings with respect to the variables we have constructed, like FLFPR and MOSPCT, apply only to the variation among the fertility means of the 120 observation groups. They constitute only indirect evidence on the influence of those variables on the fertility of Soviet mothers in general. The point can now be expanded upon.

Variables like URB and ED in this study are variables of classification; the Soviet population was initially sorted by those variables (and by republic) which produced the 120 observation groups, the mean fertility of which is our dependent variable. Since we have separate fertility measures for the four ED levels, for example, we have a basis for drawing inferences about the influence of ED on the fertility of Soviet mothers in general. In the case of the variables we have calculated independently, however, we have only measures of the mean value for each observation group; mean labor force participation rate of, say, ED3 urban mothers in the Ukraine. We have no way of knowing, however, whether or how fertility varies with FLFPR within that group of mothers.

Suppose, for example, that the fertility of individual mothers in fact varied greatly with FLFPR. Within each observation group, therefore, the fertility of the mothers would vary greatly with their FLFPR.
Suppose now that there were two groups in which the mean FLFPR were the same but mean fertility was different. We would find correctly, that none of the difference in the fertility means can be explained by FLFPR. But that finding is not inconsistent with the possibility that FLFPR may exert a strong influence on the fertility of Soviet mothers.

Our constructed variables, however, do reveal a considerable range of variation among observation groups; the coefficients of variation of FLFPR and MOSPCT are 13.2% and 131.4%, as reported above. If the data then reveal a significant negative relation between fertility means and FLFPR means, there is a strong presumption that that negative relation also describes the behavior of the individuals within the groups. It is still possible that both fertility and FLFPR are functionally related to some third variable Z, and that for given values of Z there may be no relation (or even a positive relation) between fertility and FLFPR. However, we have already introduced those variables that are most likely to be related to both fertility and FLFPR (e.g., per capita income, percentage of Moslems), and the negative relation between the means of fertility and FLFPR persists. We conclude therefore that the relations we have found among group means probably reflects the underlying relations in individual behavior, though our estimates of the magnitude of the relations may be biased. This caveat however, does not apply to the classifying variables of education and residence.
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Part II - Appendices
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Source: TsSU, Itogy...1970 goda, vol. VII, Table 37, pp. 452-453.
### Table B. Numbers of Women Aged 20-54 by Republic, Education and Residence, USSR, 1970 (in thousands and percentages)

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**Source:** TsSU, Itogy...1970 goda, Vol. III, Table 1.

**Note:** Figures in parentheses are percentages.
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**Source:** TsSU, Itogi...1970 goda, vol. III, Table 1.

**Method:** Vol. III of the USSR 1970 Population Census contains data on numbers of women by republic, age, education level, and residence. The figures in this table are the weighted average ages of all women between the ages 20 and 54 in the categories specified.
### Table D. Average Number of Children by Age of Mother, Republic and Residence

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</table>


Method: The data are presented in the source in the form of numbers of families with 1, 2 and 3 or more children, by age of mother. The data above are weighted averages of the number of children for mothers in each age-interval. The mean number of children in families with "3 or more" children was taken to be 3.37 children; this was based on the data in Table 28 of the source, which provides data on families with 3.4 and "5 or more" children.
### TABLE E. AGE-ADJUSTMENT FACTORS

<table>
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<th>Republic</th>
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<td>1.01</td>
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### TABLE F. AGE-ADJUSTED NUMBER OF CHILDREN PER THOUSAND MOTHERS BY REPUBLIC, EDUCATION OF MOTHER AND RESIDENCE, USSR, 1970

<table>
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<tr>
<th>Republic</th>
<th>ED4 Urban</th>
<th>ED3 Urban</th>
<th>ED2 Urban</th>
<th>ED1 Urban</th>
<th>ED4 Rural</th>
<th>ED3 Rural</th>
<th>ED2 Rural</th>
<th>ED1 Rural</th>
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<tbody>
<tr>
<td>Russia</td>
<td>1,519</td>
<td>1,734</td>
<td>1,687</td>
<td>1,769</td>
<td>1,795</td>
<td>1,998</td>
<td>2,220</td>
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<td>Ukraine</td>
<td>1,504</td>
<td>1,612</td>
<td>1,662</td>
<td>1,730</td>
<td>1,659</td>
<td>1,856</td>
<td>1,949</td>
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<td>1,159</td>
<td>2,350</td>
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<td>1,681</td>
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<td>1,877</td>
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Table G. MOSLEM WOMEN OVER 11 As A Percentage Of All Women Over 11, By Republic, Education, and Residence, USSR, 1970.

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<th>ED1</th>
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<td>1.9</td>
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<td>75.5</td>
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*NOTE: 0.0 - means less than 0.05%
The ethnic structure of the union republics is published in vol. IV, Tables 2-29 of the 1970 USSR Census. The tables of educational distribution by republic and nationality are published in vol. IV, Tables 37-53, 1970 USSR Census. However, while the ethnic structure tables contain virtually all nationalities in each republic, the educational distribution tables include only a few major ethnic groups. It was, therefore, necessary to make various assumptions regarding that distribution in the case of nationalities for whom the data are not available.

In constructing the educational distribution of Moslem women over 11 by republic and residence there were several problems stemming from the lack of data; a
1) the number of women in/particular ethnic group 11 years old or older was not known;
2) while most of the Moslems in the Central Asian republics were listed by education, sex and nationality, the same was not true in the case of the European and Caucasian republics (except RSFSR and Azerbaidzhan). Moreover the tables of the educational distribution in the Baltic republics, Moldavia and Belorussia did not include any Moslem nationalities residing in those republics;
3) in some cases the educational distribution of Tatars was so drastically different from that of other Moslems in a given republic (with ED4 and ED3 percentages much higher than the same categories of other Moslem nationalities) that it had to be treated separately.

In view of these problems certain proxies were used. To determine the number of women over 11 within a particular Moslem nationality in a particular republic we applied the percentage of all women over 10 in that republic. To find the percentage of all women over 10, we used vol. III, Table 1 of 1970 USSR Census, where all women (regardless of nationality) were listed by age as well as
by education. In sum, it was assumed that the number of women over 11 is only marginally smaller than the number over 10 and therefore the two numbers were treated as approximately the same. Thus, for example, if the number of Tatars in Estonia is 20,000 and the percentage of all women over 10 in Estonia is 75% then it is assumed that the number of Tatar women over 11 in Estonia is 20,000 x .75 = 15,000.

In determining the distribution of women of a given Moslem nationality by education when that distribution is not available, different republics or groups of republics were treated independently. According to Vol. IV of the 1970 Census, Tatars are the only identified Moslem minority living in the Baltic republics, Belorussia and Moldavia. However, Tatars' educational distribution in these republics was not known. Therefore, after calculating the number of Tatar women over 11 in those republics we used the educational distribution percentages from the Tatar ASSR (within the RSFSR) for which that distribution was available.

In the case of the Georgian SSR, the educational distribution of non-listed Moslem women (i.e., not listed in the educational distribution table) was assumed to be the same as that of Azerbaidzhan is--the only Moslem nationality for whom educational distribution was available. The educational distribution of non-listed Moslem women in the Azerbaidzhan SSR is taken to be the same as the educational distribution in the whole of the republic. The same assumption was made for the Uzbek SSR.

A different approach was taken for Kazakhstan, Tadzhikistan, Turkmenea and Kirghizia. In these mostly Moslem republics we calculated the weighted average distribution by education of all Moslem nationalities listed in/educational distribution table and applied it to non-listed Moslem nationalities. In these particular republics the Tatars were deliberately excluded from the calculation of weighted average distribution by education since their percentage in ED4 and ED3
was significantly higher than that of other nationalities. This measure, it was reasoned, allowed us to obtain a more unbiased distribution.

In the cases of the RSFSR and the Ukraine the non-listed Moslems who have their own ethno-administrative entities were assumed to have the same educational distribution as they have in those regions. In retrospect, it may have been better to apply, for example, the educational distribution of the whole of the Uzbek SSR to the Uzbeks living in the Ukraine. This assumption is justifiable because the patterns of behavior of Uzbeks living in the Ukraine are somewhat "diluted" by non-Moslems ways just as norms of life in a Moslem republic may have been influenced by the presence there of Russian, Ukrainians, Estonians, etc. The Moslem nationalities who are not grouped into any administrative regions. were not included in any of the RSFSR or Ukraine tables.
### Table H. Agricultural Employment, Income and Consumption, By Republic

<table>
<thead>
<tr>
<th>Republic</th>
<th>Percentage of Employed Population Engaged in Agriculture, 1970 (A70)</th>
<th>Income Per Capita, 1966 (USSR = 100)</th>
<th>Consumption Per Capita (USSR = 100)</th>
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</thead>
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<tr>
<td>Russia</td>
<td>18.9</td>
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<td>107.9</td>
</tr>
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<td>30.8</td>
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<td>95.9</td>
</tr>
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<td>Belorussia</td>
<td>35.2</td>
<td>89.5</td>
<td>94.4</td>
</tr>
<tr>
<td>Uzbekistan</td>
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<td>91.2</td>
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<td>70.5</td>
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<td>83.3</td>
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<tr>
<td>Estonia</td>
<td>17.3</td>
<td>137.2</td>
<td>131.3</td>
</tr>
</tbody>
</table>

Sources:
### Table I. Female Labor Force Participation Rate, By Republic, Education and Residence
#### USSR, 1970*

<table>
<thead>
<tr>
<th>Republic</th>
<th>ED4</th>
<th>ED3</th>
<th>ED2</th>
<th>ED1</th>
<th>ED4</th>
<th>ED3</th>
<th>ED2</th>
<th>ED1</th>
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<tbody>
<tr>
<td>Russia</td>
<td>93.3</td>
<td>81.3</td>
<td>82.9</td>
<td>98.0</td>
<td>97.1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ukraine</td>
<td>91.7</td>
<td>81.5</td>
<td>75.8</td>
<td>90.0</td>
<td>95.6</td>
<td></td>
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</tr>
<tr>
<td>Belorussia</td>
<td>90.8</td>
<td>80.1</td>
<td>80.1</td>
<td>99.0</td>
<td>95.5</td>
<td></td>
<td></td>
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<tr>
<td>Uzbekistan</td>
<td>86.6</td>
<td>66.9</td>
<td>66.0</td>
<td>75.3</td>
<td>93.1</td>
<td></td>
<td></td>
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<tr>
<td>Kazakhstan</td>
<td>88.8</td>
<td>72.8</td>
<td>74.6</td>
<td>84.0</td>
<td>95.5</td>
<td></td>
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<tr>
<td>Georgia</td>
<td>84.0</td>
<td>75.8</td>
<td>57.5</td>
<td>83.4</td>
<td>92.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Azerbaijan</td>
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<td>61.3</td>
<td>54.6</td>
<td>66.2</td>
<td>91.6</td>
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</tr>
<tr>
<td>Lithuania</td>
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<td>78.4</td>
<td>76.7</td>
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<td>96.3</td>
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<td>77.9</td>
<td>77.0</td>
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<td>86.3</td>
<td>113.5</td>
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<td>67.0</td>
<td>70.4</td>
<td>93.9</td>
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<td>94.5</td>
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<td>63.2</td>
<td>73.0</td>
<td>93.8</td>
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<tr>
<td>Estonia</td>
<td>95.0</td>
<td>92.9</td>
<td>85.3</td>
<td>115.9</td>
<td>96.9</td>
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<td></td>
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</tr>
<tr>
<td>Unweighted means</td>
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<td>74.7</td>
<td>71.7</td>
<td>87.8</td>
<td>95.1</td>
<td>82.5</td>
<td>77.6</td>
<td>92.7</td>
</tr>
</tbody>
</table>

**Sources:** TsU, Itogy... 1970 goda. Vol. V, Tables 7 and 11 for number of women in social production. Vol. III, Table 1 for number of able-bodied women.

*Ratio of number of women in social production to number of able-bodied women. The percentage can exceed 100% because there are women in the labor force who are older (and perhaps younger) than the age interval 16-54 that defines the term "able-bodied."
A Note on Sociological and Economic Explanation

Explanations of group differences in social behavior take a variety of forms, two of which may be designated loosely as the sociological and the economic. Sociological explanation views behavior as the result of the interplay of culture and social structure. Culture defines the values that underly such decisions as whether and at what age to marry, and how many children to have and when. Social structure defines the set of characteristics that determine a person's social roles; being eighteen years old, being male, having a secondary-level education and being unmarried are the kinds of characteristics that are socially salient in the sense that they influence social behavior. According to this sociological paradigm, people who share the same cultural values and social characteristics tend to behave in similar ways. Differences in social behavior are to be explained in one of three ways: (1) the groups may share common cultural values, but may have different characteristics; both may be French, but one may be rich and the other poor; (2) the groups may have the same social characteristics but hold different cultural values; both may be poor but one may be French and the other Algerian; and (3) the groups may differ in both culture and social structure. The task of analysis is to determine the extent to which the difference in behavior is due to difference in culture on the one hand and to differences in social structure on the other.
Economic explanation—or more properly, neo-classical economic explanation—views behavior as the result of the interplay of values and scarcity. The value (or preference) system of a person or group expresses the values that underly such decisions as whether to purchase this bundle of goods or that, or whether to go to college or to work, or whether to enter the labor force or to keep house. Scarcity imposes a constraint on the choices that can be made; of all the things that a person would prefer to have or to do, many are simply not possible because of some limitations like money or time. Moreover, of the things that can be bought or done, some are much more costly, in money, pain or time, than others. Choices are then made by weighing the costs and the value associated with all of the feasible alternative's, and that alternative is finally chosen that ranks highest on the scale of values of the actor. According to this economic paradigm, people who have the same value systems and confront the same scarcity constraints will make the same choices. Differences in the choices that people make are to be explained in one of three ways: (1) they may have similar values but they may confront different scarcity constraints; the values they place on children or on automobiles may be the same, but one may be richer than the other, or the cost of children or automobiles may be higher for one than the other; (2) they may face identical scarcity constraints but the value that one places on children relative to automobiles may differ from the other's valuation; and (3) they may differ in both values and constraints. The task of analysis is
to determine the extent to which the difference in behavior is due to differences in values on the one hand and differences in scarcity constraints on the other.

Though couched in different languages the two paradigms of explanation correspond closely in several respects. The concept of "culture" as it is used in sociological explanation is very close to that of "values" (or preferences) as used in economic explanation. Both connote the orderings or rankings that persons place upon things and activities. They allude to properties that are "internal" to the individual. The concepts of social structure and constraints, on the other hand, refer to properties that describe the situation of a person and in that sense is external to him.

The explanatory power of both paradigms is greatest in cases in which one can reasonably assume that the person is "autonomous," in the sense that changes in his external situation do not change him internally, "as a person." If his income increased, his behavior would change—he would purchase more expensive suits; but only because his constraints have changed, not his values. If she marries, her behavior changes—perhaps she changes her job less often; but she is still "the same person"—only her position in the social structure has changed. Changes in one's location in "social space" alter the relative costs of alternative choices, and this acts upon behavior like the scarcity constraint in the economic paradigm.
The trouble, however, is that in many situations the individual cannot reasonably be regarded as autonomous. Changes in the external situation lead, with more or less of a lag, to changes in the "person himself." An increase in income and expenditures may not instantaneously change a person's values or tastes. But in the course of time it is very likely that his value system itself will change. Nor can the married woman be regarded as the same person as before, simply behaving now under the different constraints of a different position in the social structure. In general, changes in the external situation generate changes not only in behavior but in culture and values.

There are ways in which the dynamics of changing culture/tastes can be modelled. By the use of time-lags, for example, one could regard the tastes of people who have recently migrated from farm to city as different from those who migrated five years ago, ten years ago and so forth; and similarly for all persons who have changed social roles. The available data, however, do not make it possible to discriminate that finely. The present study therefore follows the standard practice of assuming that all members of given nationality share a common culture, and that behavior is uniquely defined by current location in social space.
Part III. Fertility Behavior of Moslems and Non-Moslems

I. Introduction

There are two ways in which Moslems may differ from non-Moslems in their fertility behavior. First, they may differ in fertility levels, but not in their response to differences in social structure. Second, they may differ both in fertility levels and in response to social structure. In the first case, for example, one would say that rural Uzbek mothers have more children than urban Russians; but that when Uzbek rural mothers move to the city, their fertility declines at the same rate as that of Russian mothers. In the second case, one would say that Uzbek mothers differ from Russian mothers not only in the levels of their fertility, but also in their response to urbanization.

The analysis in Part II was confined to the variation in fertility levels. The linear regression models employed, however, incorporated the assumption that the effect of each independent variable on fertility is independent of the value of the other variables. That is to say, the effect of residence on fertility is the same in the Moslem and non-Moslem republics. In view of the strong influence of culture on fertility, however, one would expect that not only levels but also responses to social structure would be different for Moslems and non-Moslems.

Technically, the question is whether the responses of Moslem-republic mothers to the variables of social structure are sufficiently similar to those of non-Moslem republic mothers to justify pooling the two groups of republics as we did in Part II. To evaluate
the significance of the differences, we divided the 120 observation
groups into two subsets, with the five Moslem republics in one and the
other ten (including Kazakhstan) in the other. Applying the Chow test
of structural homogeneity (Dutta, 1975) to the regression on ED and
URB, we found an $F$-value 51.3, well beyond the .99 significance level.
That is to say, the difference between the Moslem-republic and non-
Moslem-republic regression coefficients is so large that they cannot
be considered members of the same behavioral structure.

In this Part we therefore pursue the analysis on the two subsets
of republics separately. The Moslem republics are defined as those in
which the percentage of Moslems exceeds 50%. They include Azerbaidzhan
(82.8%), Tadzhikistan (82.8%), Uzbekistan (80.2%), Turkmenistan (78.8%),
and Kirghizia (58.5%). The non-Moslem republics are those in which
the percentage of Moslems is less 10%. This group includes all the
other republics except Kazakhstan. That republic, 36.5% of the population
of which is Moslem, is so mixed in its nationality that it is excluded
from the analysis below.

The data are those developed in Part II above.

2. Moslem and Non-Moslem Fertility

Table 1 presents the results of the regressions on the two
groups of republics. The republics differ, first, in levels of fertility.
The mean number of children per thousand mothers in the five Moslem
republics is 2923.2 (Table 1), which is 54% larger than in the nine
non-Moslem republics (1893.8). Since the number of observations is
reduced, there are fewer degrees of freedom and a number of the
**Table 1. Moslem and Non-Moslem Fertility**

<table>
<thead>
<tr>
<th>Percentage of Variation Explained(^1)</th>
<th>Coefficient Estimates(^2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moslem (1)</td>
<td>Non-Moslem (2)</td>
</tr>
<tr>
<td>ED4</td>
<td>21.5 (3.7)**</td>
</tr>
<tr>
<td>ED3</td>
<td>18.5 (9.7)**</td>
</tr>
<tr>
<td>ED2</td>
<td>0.2 (0.2)</td>
</tr>
<tr>
<td>ED</td>
<td>40.2 (13.6)</td>
</tr>
<tr>
<td>URB</td>
<td>48.6 (2.3)**</td>
</tr>
<tr>
<td>YMAC</td>
<td>0.0 (0.0)</td>
</tr>
<tr>
<td>A70</td>
<td>0.0 (0.1)</td>
</tr>
<tr>
<td>FLFPR</td>
<td>2.9 (7.1)**</td>
</tr>
<tr>
<td>MOSPCT</td>
<td>3.6 (3.6)*</td>
</tr>
</tbody>
</table>

**Mean Fertility**

<table>
<thead>
<tr>
<th>Number of Observations</th>
<th>Moslem</th>
<th>Non-Moslem</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>95.3</td>
<td>74.3</td>
</tr>
<tr>
<td></td>
<td>40</td>
<td>72</td>
</tr>
</tbody>
</table>

**Notes:**

1. The reported figures represent the incremental sum of squares. The figures in parentheses measure the increase in the sum of squares if the variable is added last.

2. Figures in parentheses are t-values.
estimates are not significant. But most of them are significant, and they reveal certain strikingly different responses to the variables of social structure. The major differences is that ED and URB account for the overwhelming proportion of (88.7%) of the total variation in the fertility of the 40 observation groups in the Moslem republics, while they account for only 26.2% in the case of the 72 non-Moslem observations. In part that reflects the generally greater homogeneity of the Moslems republics. Four statistically significant variables (ED, URB), FLFPR and MOSPCT) account for 95.3% of the total Moslem variation while six significant variables account for only 74.3% of the total non-Moslem variation. That is to say, to predict the fertility of a homogeneous* group of mothers in the Moslem republics, all one needs to know is whether they are urban or rural and what their education level is; with that information one could produce a highly accurate prediction. If one knew the percentage of Moslems in the group and its labor participation rate one could add a bit more to the accuracy. But if one knew only the education and residence of a group of non-Moslems mothers, one could predict relatively little about their fertility. One would need to know a lot more—the per capita income of their republics (YMACE), the percentage of Moslems (MOSPCT) and so forth—and even then one could not predict fertility as accurately as in the case of the Moslem republics.

---

*Homogeneous with respect to education, residence and republic.
The regression coefficients indicate that with respect to the two variables ED and URB, Moslems are more responsive to change than non-Moslems but the reverse is true of most of the other variables of social structure. A thousand Moslem* mothers who acquire a higher education (ED4) will have 557.4 fewer children, while a thousand non-Moslem mothers will have 345.8 fewer children. Similarly the impact of general secondary education (ED3) and of moving to the city is also greater on Moslem than on non-Moslems. Hence if the state wished to reduce Moslem fertility, that is where the levers lie. The trouble is that the effort required to induce Moslem women to acquire more education and to move to the city may be very large. But when it does succeed, the fertility-reducing impact is relatively large. While the absolute decrease in fertility is larger for Moslems than non-Moslems, however, the relative decrease is diminished because Moslem fertility levels are higher. As percentages of their respective mean fertility levels, the decrease associated with ED4 is 19.1% for Moslems and 18.3% of non-Moslems. The corresponding figures for the responses to urban residence are 21.4% and 16.6%.

*For convenience of exposition, here and in what follows, the terms "Moslem" will be used to refer both to mothers in the five Moslem republics, and to mothers who are Moslem by nationality. The specific meaning will be clear from the concept.
We noted in the analyses of the pooled data in Part II that when female labor participation is added to the regression equation, certain striking changes occur in the education coefficients: (1) the coefficient of ED3 becomes larger (negatively) than that of ED4; and (2) the coefficient of ED2 becomes much larger and becomes statistically significant. We now see, in Table 1, that the first of those two results holds for both the Moslem and non-Moslem republics. But the second holds only in the non-Moslem republics. In the Moslem republics the coefficient of ED2 remains relatively small and is not statistically significant. Discussion of this point will be deferred to the next two sections where we explore urban-rural differences.

With respect to the constructed variables, female labor participation is significant for both groups and is approximately of the same size. In view of the higher mean fertility of Moslems, however, the response is relatively smaller. A 10% increase in female labor participation decreases Moslem fertility by 4.5% (i.e., 131÷2923.2) and non-Moslems by 8.6%. Hence Moslem fertility is more inelastic with respect to labor participation than non-Moslem.

The difference is sharper with regard to the percentage of Moslems. Among the forty observation groups in the Moslem republics, a ten percent increase in MOSPCT increases fertility by 139 children per thousand mothers, or by 4.8% of the mean. In the non-Moslem republics the corresponding increase is 28.9%. That result reflects in part what may be called the law of "diminishing marginal reproductivity;" that is to say, a one-percent increase in the more fertile Moslem population will have a larger impact on the average fertility of a group with few Moslems than
of a group with many Moslems. But there is also a possibility that the pressure of more fertile Moslems actually changes the fertility behavior of non-Moslems. Indirect evidence in support of this possibility is the finding by Darskii (1979, p.12) that the fertility of Russians living in Moslem republics is higher than the fertility of Russians living in the RSFSR or in other non-Moslem republics. Our results suggest that the fertility of Russians may be increased by coexistence with Moslems not only in the Moslem republics but also in the non-Moslem.

In the pooled data in Section II, one of the central questions was the influence of differences in culture-based tastes on the variation in fertility. When the data are divided into the Moslem and non-Moslem republics, however, the major source of culture difference is eliminated, and we would expect the influence of culture to vanish. It does not in fact fully vanish, because neither group of republics is perfectly homogenous in culture. The measured influence of culture difference does become much smaller, however. Percentage of Moslems accounts for only 3.6% of the variation in the Moslem republics and 10.3% in the non-Moslem—both in cases after the specified differences in social structure are controlled for. The figure of 10.3% for the non-Moslem republics (which exclude Kazakhstan) reflects the sizeable number of Moslems, particularly Tatars, in several of those republics. That figure, and the large regression coefficient (54.8), remind one that the influence of the Moslem-non-Moslem culture difference is far from negligible even in the non-Moslem republics.
Finally, our measure of the rurality of the republic—percentage engaged in agriculture (A70)—is significant only in explaining some small portion of the non-Moslem variation, and its coefficient in small and not significant in either group. We therefore drop it from the analysis to follow. Per capita income (YMAC), which is partially correlated in the non-Moslem republics, is significant in the non-Moslem republics and we retain it in the analysis to follow.

3. Urban-Rural Differences

In the preceding section we tested for differences in the responses of Moslems and non-Moslems to differences in social structure. Within each group of republics, however, the linear regression model still imposes certain uniformities in response, where in fact there may be differences in response. In Table 1, for example, the model requires that the response to variations in female labor participation be the same for urban and rural mothers, in each group of republics; in fact, rural and urban mothers may respond quite differently. To explore that possibility, in this section we separate the two groups of republics into urban and rural subgroups.

Table 2 presents the results of the regression for what are now four sub-groups: Moslem and non-Moslem urban and rural. The numbers of observations are now reduced to only 20 for each Moslem sub-group and 36 for each non-Moslem. The degrees of freedom are therefore greatly reduced but most of the estimates are still statistically significant.
Table 2. Moslem and Non-Moslem Fertility. By Residence

<table>
<thead>
<tr>
<th></th>
<th>MOSLEM</th>
<th>NON-MOSLEM</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Urban</td>
<td>Rural</td>
</tr>
<tr>
<td>Percentage</td>
<td>Model I-A</td>
<td>Model I-B</td>
</tr>
<tr>
<td>of Variation</td>
<td>44.7(69.8)</td>
<td>44.7(6.3)</td>
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<tr>
<td>Explained</td>
<td>39.6(24.0)</td>
<td>39.6(24.0)</td>
</tr>
<tr>
<td>ED4</td>
<td>44.7(69.8)</td>
<td>44.7(6.3)</td>
</tr>
<tr>
<td>ED3</td>
<td>32.5(38.3)</td>
<td>32.5 (13.2)</td>
</tr>
<tr>
<td>ED2</td>
<td>6.3(6.3)</td>
<td>6.3(2.9)</td>
</tr>
<tr>
<td>ED</td>
<td>83.5</td>
<td>83.5</td>
</tr>
<tr>
<td>YMAC</td>
<td>0.0(0.3)</td>
<td>0.2(0.4)</td>
</tr>
<tr>
<td>FLFPR</td>
<td>8.9(1.3)</td>
<td>7.4(3.2)</td>
</tr>
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<td>MOSPCT</td>
<td>4.9(4.9)</td>
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<tr>
<td>Total (R^2)</td>
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<td>97.3</td>
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<tr>
<td>Coefficient</td>
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<td>Estimate</td>
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<tr>
<td>ED4</td>
<td>-1133.6**</td>
<td>-579.9**</td>
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<td>-374.7**</td>
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<td>9.6</td>
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<td>-21.8</td>
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<td>13.4**</td>
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<tr>
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<td>3218.8**</td>
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<tr>
<td>Mean</td>
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<td>3423.2</td>
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<tr>
<td>Number of Observations</td>
<td>20</td>
<td>20</td>
</tr>
</tbody>
</table>

**Signifies significance of .01 level.
* Signifies significance of .05 level.

Notes:
1. The reported figures represent the incremental sum of squares. The figures in parentheses measure the increase in the sum of squares if the variable is added last.

2. Figures in parentheses are t-values.
Two sets of estimates are calculated for each sub-group: Model A, in which only the education variable is included; and Model B, in which three added variables are included.

The analysis of variance in Table 2 reveals no major urban-rural differences. Two minor clarifications merit attention, however. In Table 1 the explanatory power of education in the Moslem republics (40.2%) is 3.4 times that in the non-Moslem (11.7%). When rural and urban are separated, the difference widens, to 6.4 times for the urban groups and 5.3 times for rural groups. Thus the pooling of the urban and rural observations in Table 1 obscured somewhat the relative explanatory power of education. Secondly, in the pooled data in Table 1 ED4 has greater explanatory power than ED3 in the Moslem republics, but less in the non-Moslem. Table 2 indicates that that result is due entirely to the urban subgroups (Models I and II). In the rural subgroups the ED4 and ED3 explain equal proportion of the variation. That result presumably reflects primarily the greater variance of ED4 attainments in the urban observations.

The coefficient estimates indicate that the inversion of the relation between ED4 and Ed3 that occurs when female labor participation is included in the regression, holds for both urban and rural observations. In all four B models in Table 2 the ED3 coefficient exceeds the ED4, while in all the A models the opposite relation holds. That result was first found in the pooled data in Part II. It was argued there that the lower fertility of ED4 mothers in the original pooled data (Charts 1 and 2) reflected not differences in tastes for children but differences in labor force participation rates. To the extent that fertility and labor force participation are interdependent decisions, it may be
Two sets of estimates are calculated for each sub-group: Model A, in which only the education variable is included; and Model B, in which three added variables are included.

The analysis of variance in Table 2 reveals no major urban-rural differences. Two minor clarifications merit attention, however. In Table 1 the explanatory power of education in the Moslem republics (40.2%) is 3.4 times that in the non-Moslem (11.7%). When rural and urban are separated, the difference widens, to 6.4 times for the urban groups and 5.3 times for rural groups. Thus the pooling of the urban and rural observations in Table 1 obscured somewhat the relative explanatory power of education. Secondly, in the pooled data in Table 1 ED4 has greater explanatory power than ED3 in the Moslem republics, but has less in the non-Moslem. Table 2 indicates that that result is due entirely to the urban subgroups (Models I and II). In the rural subgroups the ED4 and ED3 explain equal proportion of the variation. That result presumably reflects primarily the greater variance of ED4 attainments in the urban observations.

The coefficient estimates indicate that the inversion of the relation between ED4 and ED3 that occurs when female labor participation is included in the regression, holds for both urban and rural observations. In all four B models in Table 2 the ED3 coefficient exceeds the ED4, while in all the A models the opposite relation holds. That result was first found in the pooled data in Part II. It was argued there that the lower fertility of ED4 mothers in the original pooled data (Charts 1 and 2) reflected not differences in tastes for children but differences in labor force participation rates. To the extent that fertility and labor force participation are interdependent decisions, it may be
argued that taste differences are still involved; ED4 mothers are aware that high labor force participation means having fewer children, and they would not be engaged in social production with the same frequency as ED3 mothers unless they assigned a relatively lower value to children. That argument, however, ignores the independent effect of relative wage rates on labor force participation. If ED4 wage rates were higher than ED3, then the opportunity cost of children would be higher for ED4 mothers and they would choose to have fewer children even if their tastes were identical to those of Ed3 mothers. The fact that the inversion of the relation between the ED4 and ED3 coefficients holds for both Moslem and non-Moslem and for urban and rural observations lends strong support to that interpretation.

In the case of ED2, Table 2 yields a new result, the discussion of which is reserved for the next section.

With respect to the other variables, there are no major differences between urban and rural responses in the Moslem republics. In the non-Moslem republics, several interesting urban-rural differences emerge. In Table 1 neither female labor participation nor percentage of Moslems showed any major explanatory power. Table 2 shows however, that that result was the consequences of the pooling of urban and rural observations. Among the urban non-Moslem mothers FLFPR has the largest explanatory power, accounting for 30.6% of the variation in the fertility means.* Among the

* The Type IV SS variance measure (in parenthesis) signifies that if FLFPR were entered last, after MOSPCT, its explanatory power would be about the same: 30.1%.
rural non-Moslem mothers it is much smaller, about the same as among rural Moslem mothers. The coefficient (for the urban non-Moslem mothers) is -34.5 children per thousand mothers. As a percentage of the average fertility of that subgroup (171.1.9), it amounts to 2.0%. That is, the elasticity of fertility with respect to female labor participation is 2.0, which is quite high indeed. The corresponding elasticities in the other three subgroups are all in the range of 0.6 to 0.7. Hence, to the extent that Soviet fertility has been influenced by state policy regarding female labor participation, it is among the urban non-Moslem women that the influence has been greatest. The policy implication is that if the state wished to increase fertility with the minimal loss in female labor power, it should concentrate on the urban non-Moslem women.

The percentage of Moslems, however, explains virtually none of the variation among urban non-Moslems but a very large part—23.5%—of the among rural non-Moslems. That result reflects in part the greatest variance of MOSEPCT in rural non-Moslem regions (Part II, Appendix Table G). But the coefficient is also quite large. Hence in republics like Russia and Armenia, which have the largest percentages of Moslem women among the non-Moslem republics, the republic fertility rate is heavily influenced by the cultural impact of their rural Moslems.
4. A Case of Premature Modernization

The separation of the urban and rural observations in Table 2 yields one new result with respect to ED2. The finding for the non-Moslem republics in Table 1 holds for both urban and rural sub-groups in Table 2: the addition of FLFPR greatly increases the coefficient of ED2. In the urban sub-group (Model III-B) it even greatly exceeds the coefficient for ED4, signifying that when FLFPR is controlled for, ED2 mothers have even fewer children than ED4 mothers.* A similar relation holds for the urban observations in the Moslem republics (Model I-B); ED2 is statistically significant and much larger than the all-Moslem ED2 coefficient in Table 1 (Col.(3)). The rural Moslem coefficient differs from the other three, however, in three ways: (1) it is not significant statistically, either in Model II-A or II-B, (2) its absolute size is very small, compared to all the other B models; and (c) its sign is positive while in the other three groups the sign is negative.

The difference in responses of urban and rural Moslems to ED2 was obscured in the pooled Moslem data in Table 1, where the coefficient is negative, small (-99.4) and not significant. The separation of the subgroups shows that the urban Moslem mothers respond in a way very similar to both urban and rural non-Moslems: fertility drops sharply with the acquisition of an ED2 education when FLFPR and MOSPCT are not controlled for (Model I-A), and even more sharply when they are (Model I-B); and

*The rural ED2 coefficient, however, is smaller than the ED4 (Model IV-B), and is not significant. Hence the result in Table 1, column (4) is dominated by the urban observations.
the coefficients are significant. But the rural Moslems appear to behave differently from the three other sub-groups.

The difference is apparent in the original data, in Chart 2. In four of the five Moslem republics (Azerbaidzhan, Uzbekistan, Turkmenia and Kirghizia), fertility rises between ED1 and ED2, while only in Tadzhikistan does it decline slightly. The unweighted average change in an increase of 170 children per thousand mothers, which is the dummy variable ED2 coefficient in Table 2, Model II-A. When FLFPR and MOSPCT are included, the magnitude of the rise is modified to 55.7 (Model II-B), but it is still positive, though not significant statistically. The evidence is not decisive but is strongly suggestive that this subgroup differs from the others in an interesting respect: the effect of some exposure to secondary education (ED2) is to increase the fertility of Moslem mothers rather than to decrease it.

Why should ED2 have that unusual effect in a population whose fertility is already the highest in the USSR? Before offering our interpretation, we note certain similar findings in other societies. In Ben Porath's (1973, p. 205, Table 6) study of fertility in Israel, among women who had been married in Israel those with 1-4 years of schooling had significantly more children than those with no schooling.* The first returns of the World Fertility Survey reveal that in Kenya and several other African and Asian countries women with no schooling have a lower fertility rate than women with primary-school education.**

* Curiously, it was the fertility behavior of women of European descent rather than Oriental descent that produced this result.

A study of Philippine fertility (Klebanoff, 1980) reports that the coefficient of "use of contraceptives" is positive, that variable presumably serving as a proxy for education.

The researchers of the World Fertility Survey are reported to have concluded that "In some cases a little bit of modernization can go the wrong way, sweeping aside social customs and taboos that naturally restrain childbirth—without replacing them with an offsetting use of contraceptives." One example is the substitution of bottle-feeding for breast-feeding; the latter has traditionally acted as a natural method of birth control. In Kenya, education is often accompanied by a rejection of polygamy, an institution that also tends to reduce fertility. The author of the Philippine study attributes the result to the influence of cultural traditions; to "large families commonly desired by Filipinos."

We offer a more general interpretation based on the relationship between education and culture-based tastes. There are three channels by which education is thought to influence fertility. First is the effect of education on raising women's wage rates. In the neo-classical explanation the increase in wage rates raises the opportunity cost of children leading to a decline in fertility. The second is the effect of education on tastes; away from children toward other sources of satisfaction. The third is the effect of education on ability to regulate fertility.

All three effects are thought to lead to reduced fertility. In the case of the third channel, however, there are circumstances
in which it might lead to an increase in fertility. Normally an increase in a woman’s ability to regulate her fertility would be employed to reduce the number of births. That indeed has been thought to be the general case. It may, however, be only a special case, operating in a culture in which women desire to have fewer children. In that case increased educations will enhance their ability to do what the wish to do. But suppose a culture in which women desired to have more children then they actually had. In that case, an increase in education, by enabling them better to attain their desired fertility, would lead to an increase in the number of children.

We may suppose that rural low-education Moslem women are prototypical of a cultural world in which having many children ranks near the top of their objectives. It should not therefore be surprising that a bit of secondary education, with its accompanying effects on dietary habits, hygiene, willingness to seek and accept medical care during pregnancy, and so forth, should enable them to bear more children. For the same reason the proportion of surviving children should increase also. Once the same women are transported to an urban environment, however, the new social structure no longer supports the objective of maximum fertility. Under these circumstances the acquisition of a small degree of education enables the woman better to do what she now wants to do, which is to reduce fertility. Hence one observes the normal negative relation between education and fertility in the urban environment.
This fertility-increasing effect of education in traditional rural society applies, however, only to low levels of education. In our data, for example, it operates only in the difference between ED1--elementary or less--and ED2--same secondary education but not completed. Women who have continued in school long enough to have earned the diploma follow the urban pattern of declining fertility. In their case either or both of the other two channels of influence of education on fertility may have begun to operate. The test of the first channel is the shape of the function relation wage to education. If that relation is relatively flat up to completion of secondary education but rises discontinuously thereafter, it would lend support to the opportunity-cost explanation. The test of the second channel is whether the relation between tastes and education has a similar shape. In that case education would have very little influence on Moslem girls' ideas about family and children unless it were pursued through the secondary level and beyond. Those who have got that far, however, begin to wish to reduce fertility, and this enhanced knowledge then helps them to do so.

Summarizing the argument, the question is, why does a limited exposure to schooling increase the fertility of rural Moslem women. The interpretation we offer is that Moslem rural women with limited schooling have not yet experienced those forces of social structure or that degree of change in tastes to cause them to wish to limit fertility; but they have acquired the knowledge to enable them to attain more effectively their traditional objective of having many children.
This interpretation may also help explain the large differences in the fertility behavior of Soviet Moslems and non-Moslems in recent years. In most countries, and in earlier periods of Western history, the expansion in women's education followed in time their participation in the labor force and other social changes that caused women to desire to limit fertility. Under those circumstances education did contribute to fertility decline by enhancing the ability to control fertility. But the expansion of Moslem women's education in the USSR may have proceeded prematurely; that is, at a time when social change had not yet induced women to desire to limit fertility. Under those circumstances the expansion of education led to the unintended result of enabling women to want many children to have even more. This piece of Soviet history may serve as another instance of premature modernization "going the wrong way," in the words of the World Fertility Study.

5. Education-Level Differences

When the two groups of republics are separated into educational subsets, the numbers of observations becomes quite small: 10 in each of the Moslem educational subsets and 18 in each of the non-Moslem. The analysis is therefore confined to only three variables, URB, FLFPR and MOSPCT. The variance is sufficient to yield significant estimates for many of the coefficients. The results are presented in Table 3.
<table>
<thead>
<tr>
<th>Percentage of Variation Explained</th>
<th>ED4</th>
<th>ED3</th>
<th>ED2</th>
<th>ED1</th>
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<tr>
<td>Moslem</td>
<td></td>
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<tr>
<td>URB</td>
<td>1-A</td>
<td>1-B</td>
<td>1-C</td>
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<tr>
<td>87.3</td>
<td>87.3</td>
<td>87.3</td>
<td>87.3</td>
<td></td>
</tr>
<tr>
<td>FLFPR</td>
<td>5.5</td>
<td>2.4</td>
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<td>12.2</td>
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<td>MOSPCT</td>
<td>9.5</td>
<td>4.9</td>
<td>10.6</td>
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<td>Total</td>
<td>87.3</td>
<td>92.8</td>
<td>96.8</td>
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<table>
<thead>
<tr>
<th>Coefficient Estimates</th>
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<tbody>
<tr>
<td>URB</td>
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<td>-1211.2**</td>
<td>-448.9**</td>
<td>-898.4**</td>
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<tr>
<td>FLFPR</td>
<td>-47.7*</td>
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<td>-13.7</td>
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<td>MOSPCT</td>
<td>14.0**</td>
<td>8.2</td>
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<tr>
<td>Intercept</td>
<td>2826.4**</td>
<td>3010.0**</td>
<td>1845.8**</td>
<td>3060.4**</td>
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</tbody>
</table>

| Mean                             | 2347.3 | 2611.2 | 3324.5 | 3409.9 |
| Number of Observations           | 10     | 10     | 10     | 10     |
Table 3 (Cont). Moslem and Non-Moslem Fertility. By Education

<table>
<thead>
<tr>
<th>Percentage of Variation Explained</th>
<th>ED4</th>
<th>ED3</th>
<th>ED2</th>
<th>ED1</th>
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<td>V-A V-B V-C V-D</td>
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<tr>
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<td>18.5</td>
<td>18.5</td>
<td>18.5</td>
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<tr>
<td>FLFPR</td>
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<td>31.6</td>
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<td>60.0</td>
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<tr>
<td>Hosptct</td>
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<td>16.5</td>
<td>12.8</td>
<td>0.4</td>
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<tr>
<td>Total</td>
<td>18.5</td>
<td>50.1</td>
<td>9.4</td>
<td>66.6</td>
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<tr>
<td>FLFPR</td>
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<td>-37.8</td>
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<tr>
<td>Hosptct</td>
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<td>87.9*</td>
<td>62.6</td>
<td>11.8</td>
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<td>Intercept</td>
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<td>7585.7**</td>
<td>1721.0**</td>
<td>7248.7**</td>
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<table>
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<td>1704.0</td>
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<tr>
<td>1760.8</td>
<td></td>
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<tr>
<td>2027.1</td>
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<tr>
<td>2083.3</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

Number of Observations 18

** Signifies significance at the .01 level.
* Signifies significance at the .05 level.

Note 1: Variation based on incremental sum of squares.
The Moslem republics show little variation by educational level. As in Table 1, URB accounts for the overwhelming proportion of the variation in fertility, at all education levels. At the lowest education level (ED1), the influence of URB is somewhat smaller and that of the other variables correspondingly larger. The lesser importance of URB for ED1 also shows up in the regression coefficients. For the three higher educational levels, living in city reduces fertility by 34-40% of the respective means. But for ED1 the reduction is only 23.9%. The response of low-education Moslem mothers to living in a city is evidently less than that of those with more education.

That result is consistent with the argument in the preceding section that culture-based preferences for large families are strongest among those with the least education. The effect of urban residence is largest: on the ED2 mothers, however; the reduction is 39.9% of the mean. Evidently the fertility-enhancing influence of "premature modernization" does not withstand the double impact of both education and urbanization. That is to say, the traditionalist fertility behavior of rural ED1 Moslem women is relatively resistant either to a few years of schooling or to the move to the city. But it gives way to modern fertility behavior under the impact of both.

In the responses to other variables the only striking effect of educational difference is the impact of female labor participation on ED4 Moslem mothers. A one-percent increase in FLFPR reduces the number of children per thousand mothers by 47.7, corresponding to an elasticity of 2.0 at the mean. The other three educational
levels are inelastic in their response to FLFPR. That result, however, may reflect the relatively large number of non-Moslems among the ED4 women in the Moslem republics (See Part II, Appendix Table G.) Because of the loss of degrees of freedom we are unable to control for MOSPCT in Table 3.

In their response to urban residence, the non-Moslem education subsets are no more diverse than the Moslem. All fall in the range of 14-19% of the variation. But there is a major difference in the response to the other variables. In the pooled data in Table 1 MOSPCT accounted for about twice the variation of FLFPR (Column 2). Table 3 shows, however, that that relation holds only for the two lower education levels. Among ED4 and ED3 mothers, FLFPR accounts for a much larger percentage of the variation than MOSPCT. That result presumably reflects the larger incidence of Moslem women in the low-education subsets.

The relations among the non-Moslem coefficient estimates in Table 1 hold broadly for all education levels in Table 3. Specifically, the MOSPCT coefficients are generally larger than the FLFPR coefficients. The only striking difference among education groups in the uniform decline in the impact of labor force participation as education decreases. When FLFPR is the only added variable (Models B) a one-percent increase in FLFPR decreases fertility by 60.1 among ED4 mothers but by only 22.8 among ED1 mothers. The corresponding elasticities at the fertility means are 3.5 and 1.1, with the other two education levels falling within that range. When MOSPCT is controlled for (Models D), the corresponding elasticities are 3.4 and 0.6. The implication of this result is that rising female education levels depress fertility for two independent reasons: (1) because higher-education women participate more in the
labor force * and labor-force participation is inversely related to fertility; and (2) the higher the level of education the larger the negative impact of labor force participation on fertility.

In summary, the pooled reproductive behavior of the education subsets does not differ greatly from that shown in the pooled data in Table 1. We have found two differences, however, that merit attention. First, the negative response of fertility to labor force participation increases with education level. The increase is fairly uniform for non-Moslems but is concentrated at the ED4 level for non-Moslems. Second, the negative response of different education levels to urban residence is fairly uniform, with one exception: among low-education Moslems the response is relatively small.

*This applies only to ED2-ED4. The labor force participation curve is U-shaped, with highest rates at both ED4 and ED1. See Part II, Appendix Table I.
Bibliography


If one were to rank the characteristics of a society by the order in which they bear the stamp of culture, the language that people speak would top the list. Family organization, however, would not be far behind. One would expect, therefore, that societies with diverse cultures would diverge particularly in family organization.

Soviet family organization follows that pattern. With respect to one of the major features of family organization—numbers of children—the fifteen republics vary greatly. Taking the percentage of Moslems as the measure of the major cultural difference among Soviet citizens, the correlation between that percentage and the measure of fertility in the data studied in this paper is .82.

But culture does not uniquely determine behavior. It may be thought of as a schedule, prescribing the different forms of behavior that are appropriate under specified conditions. With respect to family behavior, the influence of culture is conveyed through the shape of the preference system for children relative to other valued things. People who share the same culture and therefore have similar preference systems may nevertheless behave differently if they confront different conditions.

From this perspective, fertility variation in the USSR reflects not only the differences in culturally-based preference systems, but also the differences in the constraints on the behavior of different groups of persons. Our study has sought to shed light on the magnitude of the influence on fertility of differences in the constraints, relative to the influence of culture-based preferences.

The original data consist of the mean fertility of 120 groups of
mothers homogeneous with respect to republic, education and urban/rural residence. We have regarded those three characteristics as bundles of various kinds of constraints that affect the cost, material and psychic, of having children relative to other valued things. Thus, we interpret the lower fertility of urban mothers as signifying that the cost of having children is higher and the cost of other things lower in urban families than in rural. We assume, in other words, that urban families have the same preferences as rural families of the same culture, and if they lived in rural areas they would have the same number of children as rural families do.

Those bundles of constraints that determine relative costs are generated by the ways in which the society organizes its social and economic activities. The ways in which one earns an income, cares for children, organizes recreation and so forth, differ according to one's location in "social space"; that is, according to one's particular set of socially-salient characteristics: being female or male, being child or adult, having a high or low education, living in a city or a village, having a high or low income, being a writer or a clerk. We refer to these characteristics as features of the social structure. People who share the same culture but occupy different positions in the social structure face different bundles of constraints. Hence, their culture-based preferences are the same but they behave differently.

Proceeding from this paradigm, we have sought to distill from the data the relative importance of culture and social structure in determining fertility in the USSR. The two, however, are not statistically independent, for culture also influences social structure. The choice of whether to move
to the city or whether to acquire a few more years of education is also influenced by culture-based preferences. Hence, we have found it useful to distinguish two effects of culture on fertility: the direct effect, reflecting culture-based preferences for children; and the indirect effect, reflecting culture-based preferences for certain positions in social structure, which in turn influence the costs of children.

Our major finding may be expressed as follows: cultural differences exert a dominating influence on fertility, but its influence is overwhelmingly indirect. It operates primarily in its influence on the choices that people make which establish them at certain locations in social space. The fertility of mothers with the same characteristics of social structure tends to be very similar, even if they are of different cultural backgrounds. Very little remains to be explained by culture when social structure is controlled for.

The following are some of the major findings of our study that support that conclusion. Of the total variation in the mean fertility of the 120 observation groups, about 30% can be explained by two major features of social structure—urban/rural residence and educational level of mother—in about equal proportions. About 60% can be explained by the differences in the republics in which the mothers reside. Of the various ways in which a republic might influence fertility, we tested two, rurality of the republic and per capita income of the republic. These two variables of social structures explain 11.8% and 30.9% of the variation in fertility. Hence, the four variables of social structure account together for 72% of the total variation. The appropriateness of considering female labor force participation as our independent variable
is in dispute, but if added, as we believe it should be, it explains an additional 1.1% of the variation. These five variables of social structure thus account together for 73% of the variation. When the effect of these social variables is controlled for, the direct influence of culture, as measured by the percentage of Moslems in each observation group, is only 13% of the variation in fertility. When the five social variables are ignored, however, the percentage of Moslems accounts for 67% of the total variation. Those last two numbers may be taken as rough indicators of the direct and indirect effect of culture. The total effect of culture accounts for 67% of the variation. Most of that effect is communicated indirectly, through the effect of culture on the five variables of social structure. When those variables are controlled for, the direct effect of culture is reduced to 13% of the variation.

The foregoing results are derived from the basic data which pools observations on groups with different characteristics. When the groups are divided into subsets a number of differences emerge that are lost in the pooled data. Three principal findings may be reported. First, in the original data mothers with higher education have fewer children than women with secondary education. But when female labor participation is controlled for, higher-education mothers have the larger number of children. That result holds both for Moslem-republic mothers and non-Moslem republic mothers, and within both subsets it holds for urban and rural mothers. Our interpretation is that mothers with higher education do not, as is sometimes held, have a relatively weaker preference for children. It is rather that they work more often outside the home, which raises the cost of children to them relative to the cost to secondary-education
mothers. If the preferences of the two education levels differ at all, it is the high-education mothers who reveal the stronger preference for children.

The second major finding in the unpooled data is that low-education rural mothers in the Moslem republics respond differently from all the other subgroups. First, when they move to the city their fertility declines by less than that of women with more years of schooling. But, more important, when they acquire some secondary education, their fertility rises. Moslem-republic rural women with a few years of secondary schooling have the highest level of fertility among the observation groups. We have found instances in other societies in which the acquisition of limited education is associated with an increase in fertility. Our interpretation is that the acquisition of limited education influences fertility primarily by increasing knowledge about the reproductive process. Normally that knowledge is acquired by women who wish to control their fertility and hence leads to a decline in fertility. But in the case of women who wish to have large numbers of children, that knowledge leads to an increase in fertility. Rural Moslem women with minimal education are typical of the latter; hence the increase in fertility observed in our results.

The third finding is that the influence of female labor participation differs greatly in the various subsets. In the pooled data it accounts for a relatively small percentage of the variation in fertility and its coefficient is relatively small. In the disaggregated data, however, its influence on fertility increases with educational level and urbanization. Among non-Moslem urban mothers the elasticity of fertility at the mean with respect to labor force participation is -2.0, and among Moslem mothers with high education it is of the same size.
Thus, our results suggest that generalizations about Soviet fertility behavior must be made with great caution. Moslems respond differently from non-Moslems in certain respects but not in others. And within each group there are certain differences between urban and rural mothers and between mothers at different educational levels. There are few generalizations that hold for all subsets.

Our results suggest one implication for further research and several implications for Soviet policy. It is not unusual in research to discover that if we wish to learn more about the relation between A and B, we must study not A and B but C. In this case, if we wish to know more about the influence of culture on fertility, we must know more about the determinants of social structure: why some groups choose to live in cities and to enter the labor force more often than other groups. Indeed, even to use the term "choose" may prejudge the findings. Sometimes a person's location in social space is not the outcome of his or her choice, but of discrimination, or of barriers to entry. In the preceding discussion I have written as if social structure is completely determined by culture. Obviously it is not. Culture-based preferences may explain part of the difference between the educational attainments of Moslem and non-Moslem girls. But part of the difference may also reflect other factors; travel distance to schools may be longer, or the quality of instruction may be poorer. In any event, the implication of our finding about the importance of social structure in the explanation of fertility is that more needs to be known about the cultural and non-cultural determinants of social structure.

The policy implications of our study depend on the population policy objectives of the Soviet leadership, which have not all been publicly expressed. One of them is surely to increase the fertility rate overall. A
A second is probably to narrow the difference in the fertility rates of the various ethnic groups; possibly, if it could be publicly stated, to increase the fertility of the Slavic population and to decrease that of the Moslem. Our results suggest a number of policies that the Soviet leadership might pursue if those were their ends. First, policies to reduce the female labor force participation rate would increase fertility generally. But for a given decrease in labor force participation, the largest increase in fertility would be attained by targeting the policy at urban non-Moslem women with higher education. In the case of Moslem women, policies to induce more of them to move to cities would depress their fertility, but we have no information on the cost of implementing that policy, which may be very high. In the case of the further education of Moslem women the appropriate policy must be highly discriminating. A general increase in the educational level of urban Moslem girls would lead to a decline in fertility. But in the case of rural Moslem girls, the policy should be targeted at those who have had one or a few years of secondary education, with the purpose of inducing them to complete the secondary school and, if possible, to continue. If, on the contrary, there were a drive to expand mass education at the elementary level for Moslem girls, the consequence might well be a rise in fertility. More education for fewer rural girls would be the preferred policy.

The broad policy implication of our findings, however, should be welcome to the Soviet leadership. If we had found the direct influence of culture to predominate in fertility behavior, it would have set a tough task for state policy, insofar as the state has a population policy. For culture is relatively intractable to direct manipulation by governments.
Neither state schools nor Ministries of Enlightenment are likely to score smashing successes in inducing people to raise or lower their desire for children relative to other things. But we have found instead that what is of major importance is social structure: getting more education, taking a job outside the home, moving to a city. These are things over which state policy can have greater influence, though there are also cultural factors not to contend with. It may be possible to persuade Moslem women that they ought to have fewer children (or non-Moslem women to have more). But they could have more success in figuring out policies to increase the benefits and reduce the costs to Moslem women of acquiring more education and moving to the city; and in so doing, entrap them, as it were, in a new social structure in which they will choose to have fewer children.
PART I. INTRODUCTION

The health system in the USSR is a social institution which deserves careful study by U.S. scholars and policy makers because it represents an alternative model of the organization of medical care: a national health service in a socialist society. At a time of national debate over the need to reform our own health system, knowledge of the finance, organization, planning and management of the Soviet health system could be useful. Socialized medicine is thought by many to offer advantages over the mixed system of private and public medical care found in the United States. Rigorous analysis of the oldest and largest socialist health institution, that of the USSR, enables one to evaluate this premise.

The Soviet health system is also of interest because it is one of the major sectors of their national economy. In 1975 the health labor force comprised 5,790 thousand persons, or 5.7% of the national total. That year 11,114 thousand rubles, or 5.3% of the state budget, were spent on health. Total health expenditure amounted to 4.3% of national income. In the mid-1970's there were 2 billion outpatient visits annually to medical facilities and 54 million patients were hospitalized. It is therefore desirable to assess the performance of an institution which operates on this large a scale.

A third reason for examining the health system is that it has an influence on important indicators of social well-being, such as mortality rates and life expectancy. The levels and trends in these indicators provide information about the success of Soviet social policy.

* This author participated in the National Council sponsored project for two months in the summers of 1979 and 1980. Because this period of research was substantially shorter than those of the other two investigators this section of the report focuses as much on work in progress as on final results.
Previous research on medical care in the USSR has revealed the existence of serious medical, social and economic problems in this Soviet institution. Among these are:

- A substantial amount of illness does not receive medical treatment.
- Medical services are distributed inequitably between social groups.
- The quality standards of medical care and medical inputs are low.
- Shortages of some inputs, such as medicines and medical equipment mean that certain effective medical procedures are unavailable to the Soviet public.
- Flaws in planning cause an inappropriate allocation of resources in the health sector.
- Allocated resources are frequently used inefficiently by medical facilities.
- The health system is underfinanced relative to the needs of the population or the desires of medical policy makers.
- The health system has been unable to avert rises in age-specific mortality rates and declines in life expectancy since the mid-1960's.

Many of these issues are examined in the 1979 Ph.D. dissertation of this author, *The Economics of the Soviet Health System: An Analytical and Historical Study, 1921-1978.* Others are covered in the 1980 Davis-Feshbach report *Rising Infant Mortality in the USSR in the 1970's.*

It is not my intention to review previous work in this report on the project 'The Economics of Soviet Social Institutions.' Instead attention is focussed on the results of new research sponsored by the National Council for Soviet and East European Research during the summers of 1979 and 1980.
The major objective of this project was to employ both western theoretical approaches and economic models in the investigation of Soviet Social institutions. Accordingly, the second section of the report does not describe the health institution in the USSR along narrow 'ministerial' lines. Instead it employs the concept of 'the production of health' developed by the human capital school health economists such as Grossman and Auster.\textsuperscript{(2,15)} Following the overview of the production process, current health conditions in the USSR are surveyed. This fills a gap in my dissertation's coverage and provides a foundation for subsequent modelling.

Section 3 presents a mathematical model of the health production process which is based upon the approach of Professor Richard Stone and the U.N. System of Social and Demographic Statistics. Work accomplished by me to date is summarized and future research plans outlined.

The final section makes use of econometric techniques to evaluate the utility of employing western models in the analysis of health production. Linear and multiplicative models of the process determining male life expectancy are specified and parameters are estimated. The results are interpreted and relevant conclusions drawn.

\textbf{PART II: The Production of Health in the USSR.}

\textbf{1. An Overview of Health Production}

The health production process is an exceedingly complex one, a point made repeatedly by western health economists such as Fuchs, Grossman, Best, Auster and others.\textsuperscript{(2)(6)(12)(15)} In most sectors of the economy it is possible to identify a production function in a relatively straightforward
manner. One can measure both the inputs of labor, capital and raw materials and the outputs of commodities and services. In the health sector, however, the task of an economist is quite challenging. One can measure inputs and the production of medical services such as dermatological consultations and appendectomies. However, these services, are only intermediate products. They are consumed by the population and interact with a continually changing illness pattern to produce positive or negative health outcomes.

Given this, it would be inappropriate to adopt a narrow approach to the examination of the institution of health in the USSR and to focus on curative medical activities. Instead an attempt should be made to evaluate the complex interaction of demographic, environmental, social, medical and economic variables which determine health outputs. This is done in Diagram 1, which presents a graphic model of the various interconnections. The diagram provides, in the first instance, a framework for describing health production. It also establishes a foundation for the quantitative modelling described in subsequent sections of the report.

The graphic model is divided into four quadrants. The first focuses on the health of the population. At any given time the population has a 'health stock' which has been determined by age, sex, and genetic variables, as well as the collective historical experience. The population consumes goods and services, an activity which has both positive and negative effects upon health. Improvements in nutrition and educational standards, and increased participation in physical exercise are beneficial. On the other hand a poor diet which results in obesity or vitamin deficiency or excessive consumption of alcohol or tobacco undermine health.
Diagram 1: The Health Production Process in the USSR
The health status of the population is further influenced by the environment, which has five dimensions: residential, family, technological, natural and microbiological. As with consumption, changes in the environment can be either good or bad for health. The current environmental situation in the USSR is discussed in detail below (pp. 13-27) so no further elaboration is made here.

The interaction of health stock, consumption and environment determines the health status of the population. Western health economists have developed elaborate indices to measure health status. (10:161-163) For the purposes of this section it is sufficient to assume a simple partition into healthy and unhealthy groups. Those who are in the second category are afflicted by one or more diseases. The aggregate of all illnesses determines the disease pattern. Given this pattern expert medical evaluation can be used to determine the need for medical services. Of course, in any society some diseases remain untreated and therefore need is not satisfied. Other illnesses are presented to the health system and demands are made for medical services.

The diagram suggests that health outputs are a function of both the scope of medical coverage and the efficacy of medical care. If curative medicine plays a positive role in safeguarding health then obviously the outcomes of untreated illness will be worse than those of treated. Thus, all things being equal, the greater the share of cases of illness presented to the health system the better health output will be.

It is well known that there are varying technologies and quality standards in curative medicine, which have a differential impact on illness. Health output therefore is dependent both on the pattern of illnesses
and the performance of the curative sector.

Many indices have been developed for measuring health output. To simplify presentation assume there are three outcomes: full health, invalidity and death. These are shown in quadrant I. In practice, the output indicators often used, and considered most reliable, are those of mortality and life expectancy.

The Soviet health system, shown in quadrant II, produces curative medical services by combining inputs of fixed capital, commodities and labor. In addition other services are provided in the functional areas of research, preventive medicine, validation, education and administration. The scale of operation of the health system is determined in part by patient demand and in part by top-level policy decisions. Associated with a chosen activity level are derived demands for the three classes of inputs.

The supply of inputs (quadrant III) is determined in the first instance by physical availability and in the second by health finance. Manpower supply comes from the labor force and new graduates of medical school. The medical-pharmaceutical industry and other branches of the national economy produce health-related goods and services in accordance with the national plan, which is in turn an expression of governmental priorities. The state budget and other sources provide the finance for the purchase of inputs for the health system.

Quadrant IV shows another interconnection between the health system and the economy. The healthy population and a proportion of invalids engage in work or study. The economically active enter the labor force and contribute to economic production. Thus there is a rather direct and measurable link between health output and national economic performance.
In my dissertation an earlier version of diagram 1 provided a framework for an extensive description of the health production process in the USSR (see Chapters VI-VIII). No attempt is made to repeat the material in this report. However, one area which received inadequate attention was that of the determinants of health status. Accordingly, new research on health conditions, the results of which are reported below, was conducted.


a. Determinants of Health Status

It was argued above that health output is a function of the interaction of the illness pattern and curative medical services. Western analysts have to date devoted much attention to the evaluation of the Soviet health system and certain output indicators such as age-specific mortality rates and life expectancy. But little effort has been made to assess changes in the national disease pattern and their underlying causes. In an attempt to fill this gap in our knowledge, trends in Soviet health conditions over the period 1959-1980 were surveyed. A rigorous, quantitative assessment of all factors was not feasible in the time available. Accordingly the essay on determinants of health status presented below is more of an outline of a future research program than a complete analysis.

Diagram 2 presents a detailed description of the determinants of health status. These can be divided into three groups: health stock, consumption and environment.* Information on changes in these factors is

*At this point it is appropriate to observe that Diagram 2 is misleading to the extent that it suggests that consumption and the environment exert an influence on the population health status only in the current period. Obviously many factors such as smoking or air pollution have long-term effects on the population. In any given period they incrementally undermine the health of the human organism. This decline in health can continue for decades before it manifests itself in the form of disease, such as cancer. With this in mind, past as well as current aspects of consumption and the environment are discussed on the following pages.
Diagram 2: Determinants of Health Status

- Urbanization
- Residential
- Housing
- Neighborhood
- Public Hygiene

- Prevalence of Extended
  - Illegitimacy
  - Marriage
  - and divorce
  - Family
  - Conflicts

- Mechanization
- Electrification
- Chemicalization
- Automobilization
- Safety Programs

- Technological
- Health Environment

- Natural: Air, Water, Land
  - Industrial Pollution
  - Transport Pollution
  - Chemical Pollution
  - Preventive Medicine
  - Viruses
  - Bacteria
  - Preventive Medicine

- Alchoholism
- Smoking
- Obesity/Vitamin Deficiency

- Negative Factors
- Positive Factors

- Consumption

- Health Status
- Ill
- Healthy

- Age
- Sex
- Genetic
- Historical Experience
outlined below. Recent trends in the Soviet disease pattern are then discussed.

b. The Health Stock of the Soviet Population

Health stock, one of the major factors which determines health status, is a function of age, sex, and genetic distributions as well as the historical experience of the population. Over the period 1959-1979 the age distribution in the USSR changed markedly because of the fall in the birth rate. The share of those under 15 fell from 29.5 to 24.1%; whereas that of the elderly (over the age of 60) rose from 9.4 to 13.2%. As there is a greater incidence and more complex patterns of illness among the elderly this would tend to worsen health status.

The sex distribution also shifted. In 1959 45.0% of the population was male and 55.0% female. By 1979 respective shares were 46.7% and 53.3%. Because males are more susceptible to accidents, cancer, heart and respiratory disease, this development further increased the disease burden.

The genetic make-up of an individual (determined at fertilization), prenatal environmental forces and the birth experience affect his/her subsequent health history. Some diseases, such as diabetes, are genetically determined whereas others such as cancer or heart diseases, are more likely among people with a certain genetic profile. Factors which undermine the health of pregnant women have an adverse effect on the health of the fetus. An infant born prematurely or one who experiences a complicated delivery can end up with abnormalities which adversely affect its health later in life. Thus, an increase in the share of the population with this weaker health stock generates changes in the illness pattern.

The Soviet Union does not publish sufficient information to determine conclusively whether there has been a deterioration in the health stock.
of the population because of genetic changes and birth-related problems. However, several Soviet authors have suggested that this is the case. (11:20)

In a 1979 book M.S. Bednyy has stated:

'In the past ten years the frequency of birth of infants with development anomalies has grown. Among the reasons for the occurrence of these anomalies, according to many authors, are genetic mutations, which are the outcome of the action on the mother of a series of exogenous factors: illnesses from epidemics of influenza, German measles, the abuse of medical preparations, alcoholic beverages, smoking, and ionospheric radiation. Diabetes, the frequency of which rose and shifted to a younger age group has had a negative effect on posterity, and has increased the prenatal death rate and the mortality rate in the first month of life.' (5:128)

In a recent article about the Davis-Feshbach report on Soviet infant mortality Professor Perevedentsev put forward as a reason for the increase the weakening of the national genetic pool. Thus it does seem that an unhealthy trend exists in the USSR.

The health stock of the population in a given time is heavily influenced by historical experiences. This observation is especially relevant with respect to a society such as the Soviet Union which has undergone rapid social change and suffered greatly from revolution and war. Many Soviet medical specialists believe that the health of those members of society who were subjected to stress and material deprivation during World War II suffered long-term damage:

'The war undermined the health of those who are now 50 years or older; those born in the period of the war were subjected to unfavorable conditions of nursing, medical care, and nutrition which were generated by the difficulties of the war period.' (5:122)

The implication is that these members of the population have a weaker health stock and that they are afflicted more frequently by illnesses and have worse disease outcomes than those born in the postwar period.
Although this is a difficult proposition to test, it is probable that a permanent deterioration in health stock of a portion of the current Soviet population was caused by the war.

c. Consumption and Health

Numerous health economists such as Grossman, Fuchs, Best and Culyer have noted that increases in real income and consumption are not always associated with improvements in health.\(^{(6, 8, 12, 15)}\) This is because consumption has both positive and negative effects. Improvements in nutrition obviously are associated with a strengthening of the body whereas overeating resulting in obesity induces strain.

Over the past two decades there have been positive consumption developments in the USSR. Real income has risen, facilitating purchase of available goods and services. The social wage, which measures collective consumption, has also risen. The diet of the population has become more varied and the share in it of meat, fruit and vegetables has gone up. The educational level has increased, which presumably facilitates more rational decision making in the health area.

On the other hand, there have been numerous unfavorable developments in consumption. Treml has shown that alcohol consumed per capita rose from 3.45 liters of pure alcohol to 6.39 over the period 1959 to 1972.\(^{(21:294)}\) Studies have shown that excessive alcohol consumption leads to obesity and the degeneration of internal organs. In any residential or technological environment those under the influence of alcohol are more prone to accidents. Thus this factor has undoubtedly had an adverse influence on the national health status. The production of cigarettes rose dramatically, from 243.4 billion in 1959 to 413.3 in 1980.\(^{(24:168)}\) Smoking has been associated
with heart disease, lung cancer and bronchitis. The growing popularity of this habit has had unfavorable consequences.

In the USSR yearly per capita consumption of sugar has risen from 24.2 kilograms in 1958 to 43.0 in 1978. Use of refined sugar has been linked to the incidence of dental cavities, diabetes and obesity. Excessive consumption of sugar, fats and carbohydrates can lead to obesity. This obviously has been a problem in the Soviet Union. Although the diet has improved and the younger generation is therefore less afflicted by this problem, many Soviet citizens over the age of 40 are overweight. This consumption-related condition has an adverse impact on health.

Deficiencies in the Soviet diet have generated other problems. Published statistics on cancer mortality rates by location in the body show that in the USSR the incidence of stomach cancer is very high relative to most other countries. Inadequate infant nutrition also undermines health status. Davis and Feshbach found evidence that the shift away from breast feeding in the USSR, in the absence of proper milk substitutes, has adversely affected infant health and facilitated the survival of rickets as an important childhood disease.

This survey of consumption in the USSR shows that in recent years there have been both positive and negative developments. On the whole it would appear that the adverse effects on health of alcoholism, smoking and obesity have more than offset gains from improvements in diet and education.

d. The environment and health

The environment in which a population lives is an important determinant of its health status and disease pattern. To clarify the effect on health of the environment in the USSR it helps to study five
environmental dimensions: residential, family, technological, natural and microbiological.

(1) The residential environment

The residential pattern has altered substantially in the USSR over the past twenty years. In 1959 100.0 million people or 48% of the population lived in cities. By 1979 there were 163.6 million urban residents comprising 62% of the total. (23:7)

Rapid urbanization has placed a considerable strain on the housing system. In the mid-1950s a severe housing shortage existed in the USSR. Housing was overcrowded in the cities, and many families shared communal flats. In rural areas most of the population lived in low quality small wooden houses. A major construction program has produced more than 2 million new housing units every year since 1958. (17:792) The amount of per capita urban living space has increased from 5.8 m² in 1958 to 8.2 m² in 1977. (17:794) However, since 1969, the annual number of new marriages, an indicator of new household formation, has exceeded that of new housing units constructed, which indicates that the gap between housing demand and supply is widening. Little has been done in recent years to raise the quality of rural housing, although the migration to the cities undoubtedly has improved indicators of space per capita in the countryside.

Another aspect of the residential environment which should be mentioned is the neighborhood. Most of the Soviet urban housing units built in the past twenty years are situated in the 'new districts' on the outskirts of cities. Typically, development in these districts is unbalanced, with housing construction completed well before the supporting facilities and services such as schools, shops, subway and bus lines, and telephone
exchanges. The quality of life in these dreary ensembles of high-rise buildings leaves much to be desired.

Water and sewage services have many deficiencies in the USSR. In the countryside the wooden houses are supplied with electricity, but very few are connected to water supply or sewage systems. (13:108) With respect to urban areas Goldman has written:

"For the country as a whole by January 1970, 1,736 out of more than 1,800 Soviet cities had at least some homes supplied with water, while only 1,205 had sewers....Major cities and regions in the USSR find themselves with seriously inadequate water supplies and sewage treatment."(13:104-105)

From available evidence it appears that water and sewage systems in urban areas have expanded since 1970. The extent to which this has resulted in health improvements is discussed below in section (4)

(2) The family environment

The family plays an important role in the determination of health status because it provides continuing care to vulnerable members of society--infants, the elderly, the ill and the disabled--and because it has an influence on consumption and safety habits. Recent family trends in the USSR have not been entirely favorable to health. Expansion of the housing stock, increased mobility and improvements in the economic status of pensioners have tended to break up the extended family. One consequence is that the number of elderly living on their own, often in infirm condition, has risen. Social and medical services for the elderly have not kept pace with the demographic changes. Another result is that younger parents are deprived of the traditional services of the babushka (grandmother), which typically includes child care, cleaning, shopping and meal preparation. Working parents cannot devote adequate attention to infants and are making greater use of child care facilities. From 1965 to 1978 the number of
children in pre-school facilities rose from 7,673 to 13,177 million. (23:417)

Since 1965 the number of marriages has risen from 8.7 to 10.7 per 1,000 and the birth rate has fluctuated around 18.0 per 1,000. However there is some evidence that rates of illegitimate birth rose in the 1970s(11:23) and divorce rates have increased from 1.6 to 3.5 per 1,000 between 1965 and 1978. It is therefore likely that the number of one-parent families has grown, as in other industrialized societies. Numerous Soviet studies have shown that the health of children in 'incomplete' families is substantially worse than in normal ones.

It is possible that the tension in the family environment may be increasing because of sex-role conflicts, growing work burdens on women and continuing housing shortages as well. Most young Soviet women, especially those in cities, work full time. This has given them financial independence from their husbands but has generated role conflict because the society supports strong male behavior patterns. This tension may explain part of the unhealthy patterns of smoking and drinking and much of the high divorce rate.

(3) The technological environment

The occupational structure and the technological level of a society have a significant influence on the population's health. Many injuries and diseases are directly linked to production processes. In addition, the technological environment, together with other environmental and consumption factors, determines the non-occupational accident rate. Finally many technologies used for production or consumption generate pollutants which cause a deterioration in the natural environment.

The Soviet Union is a rapidly industrializing society. From 1965 to 1978 the value of national income produced in industry rose from 100.1
to 216.2 billion rubles. (23:386) Over the same period the share of the labor force employed in industry and construction rose from 36 to 39%. (23:363) Mechanization, electrification, chemicalization and automobilization have all increased with ensuing unfavorable health consequences.

The Soviet Union is less mechanized than advanced western societies, but in recent years progress has been made. According to the annual statistical yearbook many branches of industry recently have experienced rapid mechanization. For example, the index of mekhanovooruzhennost' (mechanization) of labor in construction (1940 = 1) rose from 6 in 1965 to 20 in 1978. (23:111) In the agricultural sector large investments since 1965 have generated a rapid growth in the supply of machinery, as the following table shows:

<table>
<thead>
<tr>
<th>Machinery in Soviet Agriculture</th>
<th>(thousands of units)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Year Type</td>
<td>1965</td>
</tr>
<tr>
<td>Tractors</td>
<td>1,613</td>
</tr>
<tr>
<td>Combines</td>
<td>520</td>
</tr>
<tr>
<td>Trucks</td>
<td>945</td>
</tr>
</tbody>
</table>

Source: 23:208

Electrification also is proceeding rapidly in the Soviet economy. The index of elektrovooruzhenost' (electrification) of labor in industry (1940=1) rose from 4.1 in 1965 to 7.1 in 1978. (23:98) This further suggests that a significant technological intensification has occurred.
The dramatic growth of the Soviet chemical industry has posed new threats to health. Production processes themselves are dangerous and result in injury, poisonings and disease among workers, and their by-products are major contributors to land, water and air pollution. Chemical products are the cause of most non-occupational accidental poisoning and much water pollution.

The output of the chemical industry has grown rapidly in the USSR. The index of production \( (1940=1) \) rose from 15 in 1965 to 54 in 1978, \( (23:120) \) and the chemical/petrochemical share in total industrial production went up from 4.7 to 6.9 percent, \( (23:121) \). Over the same period the supply of fertilizer to agriculture rose from 26,906 to 79,002 thousands of tons, \( (23:235) \) and the output of pesticides increased from 201 to 491 thousands of tons, \( (23:151) \). It is obvious from these statistics that the amount of chemicals in the Soviet environment has substantially risen in the past 15 years.

These recent changes in the technological environment increase the potential threats to the health of the labor force. The final effect on the disease pattern, however, is strongly influenced by occupational health programs, which consist of educating workers to use the technology and establishing and enforcing work safety standards. Therefore it is necessary to examine the trends and effectiveness of these preventive measures.

The Soviet Union claims to devote much attention to the protection of workers' health. Since the early 1920s health sub-systems have existed open only to workers in certain ministries and factories. The employed also have preferential access to public medical facilities. The Ministry of Health and the trade unions finance research institutes devoted to the study of labor hygiene and safety. At these institutes safety norms and operating rules are developed which are among the strictest in the world.
Despite this there are serious problems in the area of occupational hygiene. First, all Soviet health systems, closed or public, are oriented to the provision of curative medical services. Preventive medicine is neither well-funded nor is it a high-prestige branch of the health system. From 1965 to 1975 non-capital state budget expenditure on sanitary-prophylactic programs rose from 256 to 545 million rubles, but the preventive share of the health budget remained a stable 4%.\(^{(23:536)}\) In 1974 only 0.46% of all doctors occupying positions in the Ministry of Health System were those concerned with labor hygiene.\(^{(18:183)}\) Second, the few doctors working in this area frequently are unable to ensure that safety or environmental standards are observed. Soviet medical literature abounds with stories of factories which operate in very unhealthy conditions.\(^{(14)}\) Plan fulfillment pressures and capital expenditure constraints make it difficult to correct violations even after trade unions bring hazardous conditions to the attention of the party and management. As a result of these inadequacies, the rapid changes in the technological environment in industry have had an adverse impact on workers' health.

The situation is much worse in agriculture. As shown above mechanization, electrification and chemicalization have proceeded rapidly in the countryside. But the general and occupational education standards of the rural work force are much lower than that of the urban population. The rural labor force is less adaptable to new technology and more prone to engage in dangerous practices such as drinking alcohol during the workday. Agricultural laborers therefore make many mistakes with machinery or in chemical utilization. At the same time it is more difficult for health and trade union officials to inspect and monitor work habits and
conditions. Thus the recent changes in the technological environment have generated a disastrous increase in occupational accidents and poisonings in rural areas.

Technology is not only dangerous at work. Many Soviet reports show that 'home' accidents are rising more rapidly than industrial ones. Much of this has to do with the automobile. The production of motor vehicles in the USSR rose from 616 to 2,178 thousand from 1965 to 1978. (23:161) Passenger car output grew especially rapidly; its share in the total went up from 38 to 60 percent between 1970 and 1979. (26:813) In a major change of policy, the Soviet government allowed citizens to purchase these cars for private use. This has been beneficial for the state, in that car sales have reduced the cash balances of the population, and for the individual, in that automobile ownership increases social status and travel comfort.

Automobilization has its negative sides as well though. According to Welihozkiy the contemporary road system in the USSR is neither extensive nor of high quality. Substantial driving hazards exist. When this condition is combined with the Soviet propensity to consume alcohol it generates a high accident rate. (26:831) A second major automobile-related health problem is air pollution. Goldman noted that even in the 1960s, before the upsurge in production, there was an automobile pollution problem in some large Soviet cities. He claims that 'For a variety of reasons, ...Soviet automotive vehicles spew pollution far out of proportion to their numbers'; (13:132) the cars are used longer than Western ones and therefore have less efficient combustion; the quality of Soviet gas is poor; and the sulphur content of gasoline and diesel fuels is high. Given this it is undoubtedly the case that the quadrupling of motor vehicle production since
1960 has been accompanied by a substantial increase in pollutants and a lowering of air quality in urban areas.

This survey of trends in the Soviet technological environment suggests that although recent developments may have been beneficial for the economy many have had a negative influence on the health status of the population. The technological advances in production and consumption interact with drinking habits, backwardness in social infrastructure (such as roads) and inadequate education to generate rising accident rates. Further, the by-products of the continuing rapid industrialization caused a deterioration of the natural environment.

(4) The natural environment

The natural environment is made up of air, water and land. If these resources are of good quality then this has a beneficial influence on health. But in most industrial societies the environment deteriorates because of pollution. Factories discharge waste into the air and water. The by-products of automobile combustion lower air quality. Chemical fertilizers and pesticides poison land and water. This pollution directly generates forms of illness such as poisoning or cancer and indirectly raises the prevalence of cardiovascular and respiratory diseases.(6)

There is no doubt that air pollution is a growing problem in the USSR. The rapid expansion of industry, especially of the chemical sector, and of motor vehicle utilization has substantially increased the amount of gas, smoke and dust discharged into the air. Numerous Soviet studies have determined what maximum pollution levels should be and some legislation which can be used to penalize offenders has been passed.
According to Goldman, the model anti-pollution campaign in Moscow had some success until the mid-1960s, after which time 'officials have found it difficult to prevent air quality indices in Moscow from deteriorating.' (13:136)

He claims that the situation in other cities and regions is worse than in Moscow. The main reasons for this failure in the fight against pollution appear to be poor location planning of industrial enterprises, inadequate expenditure on filtration equipment and the powerlessness of health officials relative to the large industrial ministries. (13)(19)

Soviet studies have demonstrated that air pollution undermines the health of affected populations. Bednyy, Gracheva, Borevich and others claim that pollution has an adverse effect on fetal health and produces birth defects and allergies in infants. (11:20)

In a 1976 book on air pollution and health the specialists at an Academy of Medical Sciences institute wrote:

"The prevalence of birth defects among children in large industrialized centers with developed chemical, petrochemical and machine-building industries was studied by us....On the basis of the study it was established that the indicator of prevalence of defects (per 10,000 new born) for the years 1970-1974 was 38.7-53.9 in rural localities, but in cities with developed chemical industries --- 108.5-152.2! (16:19)

Air pollution also irritates the lungs and facilitates the spread of respiratory diseases among vulnerable groups, especially the young and the elderly. (11:21)

Much evidence about this effect is available. Typical is a Latvian study published in 1978, demonstrating the link between illness rates in kindergartens and pollution from an asphalt factory:

'It should be noted that in kindergartens closer to the factory children fell ill more frequently from colds, bronchitis and diseases of the ear, nose and throat than in the control group. Children of the control kindergarten did not on the whole suffer from conjunctivitis, but in one of the kindergartens near the factory the prevalence rate of this illness in 1974 was 10.6 cases per 100 infants.
The greater prevalence of illness of the upper respiratory tract, of bronchitis and of conjunctivitis in kindergartens close to the factory allows one to conclude that one of the factors which facilitates the spread of these diseases is the increased presence of dust in the air." (3:100)

In his 1979 book on morbidity and mortality trends M.S. Bednyy writes that:

'Among the factors which facilitate the rapid spread of influenza epidemics one can pick out the general pollution of the air.' (5:133)

Thus it is probably the case that over the past several decades pollution-related deterioration in air quality has had an adverse effect on health in the USSR.

As a consequence of the problems in the residential and technological environment there has been a growth in the pollution of water in the USSR. Over the years numerous official and dissident Soviet scholars, as well as Western ones, have called attention to the worsening state of rivers, lakes and reservoirs. This pollution is unfortunate not only for the fish. Low quality drinking water is a health threat to humans; it can cause chemical poisoning, cancer and various infectious diseases.

On page 15 above it was noted that the current water system in the USSR is underdeveloped because of lack of investment in earlier periods. Some urban and most rural inhabitants are not supplied with sanitary running water. Summarizing the situation in rural Kazakhstan in 1977 Voskresenskii wrote:

'25.5% of the rural population locales are provided with centralized water supply systems, 7.9% of population points (predominantly small ones) are obligated, through various circumstances, to use only imported water, and 66.4% points use water from pit or tubular wells.' (25:11)
Naturally, it is difficult to maintain health standards in a system with such disparate sources. And even where centralized systems exist the sanitary challenges posed by pollution are growing.

There are three major sources of water pollution: sewage, industrial effluent and agricultural chemical products. Rapid urbanization has greatly increased the production of sewage. In his book Goldman writes:

'It was found that in 1969, 99 million cubic meters of unclean or inadequately treated water was discharged each day into the country's rivers and other water bodies. This is equivalent to 36 cubic kilometers a year....Although the data are fragmentary, one authority estimates that the discharge of liquid wastes will total 60 cubic kilometers in 1980.'(13:83)

He further observes that in the future '....the discharge of sewage will grow at a considerably faster rate than water consumption.' Both Goldman and Pryde make the point that constraints on social investment have meant that most sewage in the USSR is not treated either mechanically or biologically before being dumped into waterways.(13:97)(19:138) Since the polluted rivers and lakes are the sources of drinking water, these unsanitary practices increase the threat of bacteriological disease.

Industrial waste, especially from enterprises of the pulp and paper, petroleum, chemical and metallurgical industries, is a major source of water pollution. Pryde reports that:

'By 1966, about 16 billion cubic metres of industrial waste was being dumped annually into the rivers and lakes of the Russian republic alone, of which only 4.5 billion had undergone purification.'(19:138)

The rapid growth of chemicals and petrochemicals since the mid-1960s has greatly increased pollutant discharge and, according to Goldman, has seemed 'to keep pace with or ahead of the completion of facilities for added industrial treatment.'(13:99) This undoubtedly has placed additional strain on the water purification system.
Since 1965 the output of fertilizer has tripled and that of pesticide has increased eight-fold. Although these products fulfill vital agricultural functions, they also have negative side-effects, because they frequently are washed into drinking-water sources. Pryde claims this is a problem in the USSR but does not discuss trends. It is highly likely though, that this threat to health is of growing importance.

In the USSR as a whole, the increase in water pollution is barely being coped with by existing sanitation and public health programs, and in some areas there is evidence that public hygiene deficiencies have raised the incidence of water related diseases.

Pryde has reviewed the programs and procedures which exist in the USSR to protect water supplies. (19:137-138) Although these look quite good on paper he makes the point that because the Soviet government has always given highest priority to investment in the 'productive' sector the resources available for improvement of industrial and municipal waste purification facilities have been inadequate. (19:136) Even when money is allocated the construction plans are often underfulfilled and the quality of work is low. The following quote from Voskresenskii, on the current situation in Kazakstan, illustrates the problems associated with safeguarding water supplies:

'Together with that, in the design, construction and use of water supply facilities in the villages there are also serious deficiencies. Thus, the plan of construction of rural water-pipes for the period 1972-1975 was only 51.3% fulfilled by the Ministry of Agriculture. As a result of the introduction into use of waterpipes without zones of sanitary safeguard, purification buildings and disinfection installations, and of the poor utilization of existing water systems in a series of places one can notice a worsening of the quality of drinking water according to bacteriological indicators.
An analysis of water-related epidemic outbreaks of intestinal infection in rural localities of the Kazakh SSR in recent years showed that the main causes are flagrant violations in the use of facilities of centralized water supply. One observes accidents in the systems, and interruptions in the supply of water, which significantly complicate sanitary-epidemiological conditions. (25:12)

These problems are probably common throughout rural areas. In cities water purification capabilities are better, but industrial and sewage pollution worse, so the campaign to combat health threats is undoubtedly not completely successful.

It was mentioned above that bad water can have adverse effects on health in several ways. A quick survey of Soviet literature provides no evidence linking polluted water with either poisonings or cancer. However, available information suggests that pollution of drinking water does cause bacteriological and parasitological problems. To see the effect this has on human health it is necessary to examine the microbiological environment.

(5) The microbiological environment

Among the major sources of disease are microbial agents such as viruses and bacteria. These agents are always present in the environment but their effect on man's health varies. The variation stems from changes in socioeconomic conditions, public health measures and alterations in the genetic nature of the disease agents.

Surveying trends in the Soviet Union it is evident that improvements in nutrition, education, housing and water supply have tended to hamper the spread of infectious disease, whereas increased density of living and pollution have facilitated it. Large scale public health programs have attempted, with mixed success, to combat the effects of pollution. They have been more successful when directed against certain disease agents such as malarial parasites and the poliomyelitis virus. On the other hand,
there have been genetic changes in some viruses in recent decades. The new strains are more virulent and resistant to natural immunities and medical countermeasures.

The recent history of the influenza virus in the USSR illustrates how the microbial environment can change. Influenza is caused by an extremely resilient and flexible airborne virus. Because of its bad weather conditions, polluted urban air and crowded homes and public facilities the Soviet Union frequently suffers epidemics of influenza. Complicating the situation is the fact that over time the virus undergoes antigenic shifts.* The new strains which emerge are not repelled either by acquired immunities of the body or by vaccines designed to combat previous influenza strains. In this event the epidemics are especially serious health threats. The report by Davis and Feshbach shows that in the period 1971-1976 there were influenza epidemics every year and that three new viral strains emerged. (11:22) This suggests that there has been some worsening of the microbiological environment in the USSR.

Bacteria are other important disease agents. In a 1977 article Aleshin stated that 14% of all illness in the USSR was comprised of dysentery of water origin. (1:14) (The prevalence of this form of illness further testifies to the inadequacy of the water supply system.) In the face of growing pollution of water from sewage and industrial wastes, existing drinking water protection and purification programs may well be inadequate. If so, then it is fully possible that the bacterial threats to the health of Soviet citizens are rising.

*Antigenic shifts refer to the changes in the genetic structure of the virus. To combat the new antigen the body must produce new antibodies naturally or through vaccination.
e. The response of the Soviet disease pattern to changing health conditions

Medical statisticians and epidemiologists have developed elaborate scientific classifications of diseases, which can be used to organize statistics about a national disease pattern. Although the Soviet Union has formally accepted the World Health Organization classifications, it has yet to publish sufficient statistics to enable one to re-construct the country's disease pattern or to measure its changes over time rigorously. Since the time constraints of this project did not enable the necessary additional research to be conducted this section presents only a subjective assessment of recent trends.

Most illnesses in a society fall into one of the following categories:
- Infectious disease - such as dysentery, malaria and influenza.
- Nutritional disease - such as rickets, scurvy and obesity.
- Degenerative disease - such as cancer, heart disease or cirrhosis.
- Accidents - such as fractures, poisonings and cuts.

The causes of diseases vary according to type but usually involve some complex interaction of health stock, consumption habits and environmental conditions. If one takes the example of lung cancer, the incidence of this form of cancer is determined by the variables measuring age, genetic stock, the prevalence of the smoking habit and air pollution. Thus it is clear that as health conditions in a society change so too will the disease pattern.

Available evidence suggests that in the Soviet Union the changes in health stock, consumption and environmental variables discussed above have significantly altered the structure of illness in the society. Among the health stock factors, the aging of the population has been especially
important. It is well known that among the elderly degenerative illnesses such as cancer, hypertension, bronchitis etc., are significant. As the share of the elderly in the total population grows, the disease pattern of a nation is altered and contains a larger share of degenerative disease. The movement of those cohorts who fought in World War II into older age is an important development. As mentioned above it is believed that the stressful experiences of these people have undermined their biological systems and have made them more susceptible to degenerative, especially cardiovascular, disease.\(^{9:112-113}\)

A number of the factors associated with consumption have exerted a beneficial influence on the disease pattern. During the period 1965-1978 the improvements in income distribution, housing and nutrition have been instrumental in reducing the incidence of infectious diseases. But the rises in cigarette smoking and alcohol consumption have generated more lung cancer, cardiovascular illness and cirrhosis of the liver.\(^9\)

Changes in the different dimensions of the environment have been important as well. The disease pattern of cities is different from that found in the countryside. In urban areas there tends to be more cancer, circulatory, nervous, and respiratory disease and accidents, and less gastrointestinal and infectious disease. Therefore the increase in the urban population share has had an important effect on morbidity and mortality rates.\(^{9:12}\)

With respect to the family environment, the decline in the practice of breast-feeding of infants, in the absence of adequate milk substitutes, has probably undermined the health of infants, making them more susceptible to gastrointestinal and respiratory diseases.\(^{11}\) Additionally, the high economic participation rate of mothers and increased availability of day care
centres has led to a rise in the share of Soviet infants in creches. This in turn has facilitated the spread of respiratory diseases, possibly increasing its importance in the infant disease pattern.\(^{(11)}\)

Among the other environmental developments, the increasing mechanisation and 'automobilisation' of Soviet life, have interacted with the excessive national drinking habits to produce more accidents at home, at work and on the highway.\(^{(9:82-85)}\) In the absence of adequate safeguards the growth of industry and the number of motor vehicles in the USSR has generated increased environmental pollution. This in turn probably has contributed to the rise in cancer and respiratory disease rates.\(^{(9)}\) Antigenic shifts in the influenza virus in the 1970s appear to have made the epidemics of influenza more severe.\(^{(11)}\)

Soviet preventive medical programs have had a generally beneficial impact. Anti-epidemic measures have resulted in the eradication or reduction in the incidence of many diseases such as measles, poliomyelitis, cholera and malaria. They also may have ameliorated the effects of influenza epidemics. Improvements in public sanitation and hygiene in food processing and distribution have lowered the incidence of gastrointestinal disease. The large scale screening programmes have identified much previously hidden illness, which is then treated by the curative branch of the health system.

Summarizing available evidence, it appears that in the past two decades there have been substantial changes in the Soviet disease pattern. Because of improvements in health conditions the significance of gastrointestinal and infectious diseases has diminished. However, the mechanisation
of Soviet society together with excessive consumption of alcohol has resulted in more accidents. The most important development, though, has been the rise in the share of degenerative diseases, brought about by the aging of the population, urbanization, pollution, etc. These diseases are more difficult and expensive to treat successfully. Therefore, throughout this time period, the tasks confronting the Soviet health system have become more complicated and challenging.


16. M.L. Krasovitskaya et. al. 'Methodological approaches to the norming of chemical substances in the air' in Metodicheskie i Teoreticheskie Voprosy Gigieny Atmosfernogo Vozdusha, Moscow, 1976.


PART III. An Accounting Model of the Soviet Health Production Process

1. Introduction

Since World War II the use of quantitative modelling of national economies has developed rapidly in both capitalist and socialist countries. Advances in empirical analysis can in part be attributed to the substantial improvements in national economic accounting in the same period. On the basis of the new accounts it was possible to make better use of econometric, input-output, flow-of-funds and income distribution models in empirical investigations.

In recognition of the important role played by accounting in economic analysis the first stage of the quantitative investigation of the Soviet health production process is devoted to the development of an appropriate accounting model. Section 2 reviews the relevant literature and identifies the most interesting approach. An accounting model of health production in the USSR is presented and discussed in section 3. Work accomplished during the project period is described. Finally areas of future research are identified.

2. The Development of Social and Demographic Accounting

An earlier paper by this author surveys the history of economic and sociodemographic accounting.\(^2\) It was found that during the 1960s there was substantial progress in the development and utilization of individual social indicators but few advances were made in the elaboration of systems of national sociodemographic statistics.

The work done in this area by Professor Richard Stone over the past decade has been of fundamental importance and provided the basis for
the accounting model of the Soviet health process. It is therefore appropriate to briefly survey the characteristics of this approach.

Stone has been interested since 1969 in using the absorbing Markov Chain Model in social analysis. To clarify the reasons for this it might be helpful to briefly describe the features of this model.*

Let \( n_t \) be a vector describing the distribution of a population across \( m \) states. Suppose there exists a Markov process defined by the equations:

\[
\begin{align*}
\mathbf{n}_t &= \mathbf{n}_{t-1} \cdot \mathbf{S} \\
\end{align*}
\]

where \( \mathbf{S} \) is the \( m \times m \) partitioned transition matrix.

\[
\mathbf{S} = \begin{bmatrix}
\mathbf{I} & \mathbf{O} \\
\mathbf{D} & \mathbf{C}
\end{bmatrix}
\]

\( \mathbf{I} = a \ (m-q) \times (m-q) \) identity matrix

\( \mathbf{O} = a \ (m-q) \times q \) zero matrix

\( \mathbf{D} = a \ q \times (m-q) \) absorption or 'death' matrix which describes transitions from life to death states.

\( \mathbf{C} = a \ q \times q \) 'survivors' matrix which describes transitions between life states.

If it is assumed that the matrix of transition probabilities is stable over time then the process is a finite Markov chain.

The chain is absorbing if these additional conditions hold:

*A Complete discussion can be found in the book by Kemeny and Snell Finite Markov Chains.*
1. For any of the q rows of D there is a coefficient greater than zero
   \[ d_{ij} > 0 \] for any i and at least one j

2. For any of the q rows of C the sum of probabilities is less than one
   \[ \sum_j c_{ij} < 1 \]

3. For the rows \( i = 1 \ldots (m-q) \) the coefficients are either one or zero
   \[
   S_{ij} = \begin{cases} 
   1 & \text{if } i = j \\
   0 & \text{if } i \neq j 
   \end{cases}
   \]

For a given live population \( \hat{n}_0 \) the survivors vector in the next period is determined by
   \[
   \hat{n}_1 = \hat{n}_0 \cdot C
   \]
and at some future period by
   \[
   \hat{n}_t = \hat{n}_0 \cdot C^t
   \]

However because the sum of life transition probabilities for any given state is < 1, then as \( t \to \infty \), \( C^t \to 0 \) and thus \( n_t \to 0 \). So the population is absorbed (or 'dies out') over time.

Thus the history of the population can be summarized by the series

Thus the history of the population can be summarized by the series
   \[
   \hat{n}_0 \cdot \sum_{t=0}^{\infty} C^t = \hat{n}_0 (I + C + C^2 + \ldots + C^t)
   \]

Since \( C^t \to 0 \) as \( t \to \infty \) the series on the right converges and its solution in the limit is

\[
\sum_{t=0}^{\infty} C^t = (I - C)^{-1} = N
\]
This limit solution is called the fundamental matrix of the absorbing Markov chain. It can be employed as a powerful social indicator describing the behavior of the Markov process in the transient ('life') states, before eventual absorption into the ergodic ('death') states (see pp. 46-47).

The Markov Chain Model and its associated fundamental matrix have been used by Stone to analyze individual demographic, educational, health and other social processes. However he has also made use of them in developing a new system of sociodemographic accounts. This work provided the foundation for a 1970 report to a U.N. Expert Group on 'An integrated system of demographic, manpower and social statistics and its links with the System of National Accounts.' After further development the U.N. accepted this approach and proposed a new set of national accounts in the document Toward a System of Social and Demographic Statistics.

This U.N. report describes a framework for the integrated accounting of those sectors of society given inadequate coverage in traditional economic accounts: population reproduction and migration, family formation, housing, social security and welfare, education and health. For each sector appropriate social indicators and models are identified and linkages are discussed. Some examples are given.

The U.N. sponsored sociodemographic accounting is still in an early phase of development. No scholars have used this approach to model an important sector of any society and no application of it, even on a microlevel, has been made in a socialist country. Despite this, it was decided to develop the accounting model of the Soviet health production process on the basis of the U.N. system.
3. An Accounting Model of the Soviet Health Production Process

Construction of the accounting model began with the graphic elaboration of the interrelationships between demographic, health and economic processes in the USSR. This produced a diagram similar to that presented above in this report (see pg. 5). Subsequently the procedures and models associated with the U.N. approach were used to describe the processes in mathematical form. The data collection effort for my Ph.D. research was organized around this first model. A later four-quadrant version provided the framework for the analysis of the economics of the Soviet health system presented in my dissertation.

In 1979 the accounting model was reviewed and future development tasks were identified in the areas of model specification, data collection, parameter estimation and system simulation. During the project period progress was made in each of these areas.

The first task was to improve the specification of the model. Earlier variants of the model were evaluated and new literature examined. On the basis of this certain aspects of the model were reformulated. The latest version is shown in Diagram 3. The accompanying table explains the notation. The complete mathematical elaboration of this model requires about 70 pages, so it was decided not to include this material in the summary project report. Only a brief description is given here.

As in Diagram 1 the mathematical model of the health production process is divided into four quadrants. In the first, the population with a given health stock, n, is influenced by a health status determination matrix, h, which in turn is a function of consumption, environmental and preventive medical variables. The result of this interaction is the
Notation of Accounting Model of Health Production in the USSR

Quadrant I: Health Status and Health Output

n = population of given health stock at beginning of period
h = health status determination
CON = consumption influence
ENV = environmental influence
H = health status
d* = persons dying outside health system
q* = persons remaining healthy
l = persons suffering illness
α, α*, α** = cases of illness already reported
p, p* = new cases of illness
w = new demand for medical services
u = total demand for medical services
d** = persons dying after medical treatment
β = persons becoming invalids after treatment
q** = persons recovering health after treatment
q = total stock health persons
ΣD = total deaths in period
Σq = total healthy in period
Σβ = total invalids in period

Quadrant II: The Health System

CS = curative medical sector Markov Chain Model
I = identity matrix
D = absorption matrix
\( O = \text{null matrix} \)
\( M = \text{curative medical sector transition matrix} \)
\( \text{CUI} = \text{inputs of curative sector} \)
\( \text{PA} = \text{Policy/Administrative sector} \)
\( \text{ED} = \text{Educational sector} \)
\( \text{VA} = \text{Validation sector} \)
\( \text{PR} = \text{Preventive medical sector} \)
\( \text{Bi} = \text{Biomedical research sector} \)
\( \text{DDMA} = \text{Derived demand for manpower} \)
\( \text{DDFA} = \text{Derived demand for facilities} \)
\( \text{DDCO} = \text{Derived demand for commodities} \)

**Quadrant III: Supply to the Health System**

\( \text{SMA} = \text{Supply of manpower} \)
\( \text{SFA} = \text{Supply of facilities} \)
\( \text{SCO} = \text{Supply of commodities} \)
\( \text{MM} = \text{Medical manpower markov chain model} \)
\( \text{E} = \text{Medical manpower survivors matrix} \)
\( \text{MC} = \text{Medical construction markov chain model} \)
\( \text{T} = \text{Medical construction survivors matrix} \)
\( \text{MAC} = \text{Medical manpower cost} \)
\( \text{FAC} = \text{Medical facilities cost} \)
\( \text{COC} = \text{Medical commodities cost} \)
\( \text{TCHS} = \text{Total cost of health system} \)
\( \text{TFHS} = \text{Total finance of health system} \)
Quadrant IV: Activities of Healthy Population

PD = Permanently disabled population
TI = Temporarily inactive population
ECA = Economically active population
EDA = Educationally active population
LF = Labor force
MLF = Medical labor force
$X_i$ = Industries supplying commodities
$X_j$ = Industries using commodities
$X_{oj}$ = Labor utilization by industries
$Y$ = Final demand
$X$ = Total output
GED = General educational system
MED = Medical educational system
health status matrix H. Those who fall ill generate a demand for medical services, u. Others die outside the health system (d*) or remain healthy (q).

Quadrant II models the Soviet health system. Its activities are divided into six functional areas: biomedical research, preventive medicine, validation, education, policy/administration, and curative medicine. A Markov chain is used to represent the treatment of patients in the curative medical sector. Patients entering the curative system either remain in one of the treatment states or are absorbed into one of the three output states: health (q**), invalidity (p) or death (d**). All the functional sectors require inputs of manpower, facilities, and commodities. Activity levels determine the derived demands for inputs (DDMA, DDFA, DDCO).

The health sector supply system is described in quadrant III. The processes producing medical manpower and medical facilities are represented by absorbing Markov chains. The manpower and materials supplied have associated costs (MAC, FAC, COC). Their total (TCHS) should be in balance with total available finance (TFHS).

The fourth quadrant shows another link between the health system and the economy. Activities of the health system influence the composition of the labor force (LF), which in turn provides the labor input to the various branches of the Soviet economy, described by an input-output model.

The second task of the project with respect to the accounting model was improvement of the data base. In the dissertation there were
discussions of data availability and estimation in the following four areas: population reproduction, health status, medical sector and health output. One problem identified was the instability of demographic coefficients, especially birth and death rates, in the USSR. This suggested that a Markov chain model of population reproduction with its stringent stability assumptions would be inappropriate. As a consequence, revisions in specification were made. A second recurring problem was lack of data. In an effort to ameliorate this, attempts were made during 1980 both to collect additional Soviet data and to explore the possibility of using information from other countries to fill the gaps in published Soviet material.

Most additional Soviet material was collected during a two-month IREX-sponsored trip to Moscow in Spring 1980. Over 200 additional references on health issues were obtained and several relevant candidate dissertations examined.

Demographic and health statistics published in the U.S. and U.K. have also been evaluated to determine the feasibility of 'splicing' this information with Soviet to expand the data base. Consultations during the summer, 1980, with faculty of the Harvard School of Public Health and with members of the Analysis Division of the National Center for Health Statistics were especially helpful.

Parameter estimation was a third area of project research. Experience with the Markov chain model in other areas demonstrates that parameter estimation is feasible if the process under study is reasonably stable and data on transition coefficients or state histories exist. In many
cases raw data exist on stocks and flows from which transition proportions can be calculated. These can then be used as the estimates of coefficients of the S matrix (see pg. 35). If this matrix of proportions is constructed from aggregation of life sequences over the history of the process then the coefficients may be viewed as consistent, asymptotically unbiased maximum likelihood estimates of the true transition probabilities. (7:23-25)

If 'prior' information about the structure of the transition matrix is available in addition to sample information, then Bayesian techniques can be used to estimate transition probabilities. (7:25-30) In many cases, however, time-ordered observations of individual state histories are unavailable, thus preventing the calculation of transition proportions. Instead one might have sample aggregate proportions which measure the distribution of the population over states for each time period.

Lee, Judge and Zellner have shown in their book *Estimating the Parameters of the Markov Probability Model from Aggregate Time Series Data* (7) that even with this limited data it is possible to estimate transition coefficients. They present eight estimators of transition probabilities which can be used with such data: unrestricted least squares; restricted least squares; weighted inequality restricted least squares; Aitken's generalized least squares; minimum chi-square; macro-maximum likelihood, Bayesian and minimum absolute deviations. In addition the authors have developed programs for actual estimation and provide numerous examples. More information of Markov coefficient estimation can be obtained from the work of Kosubud and Stokes. (5)(8) They use the minimum absolute deviation estimator to calculate the coefficients of a Markov chain describing oil market share dynamics.
The conclusion can be made therefore that

given a reasonable amount of data the estimation of parameters of a

Markov chain model is a feasible proposition. Once the transition

probabilities of a Markov chain model are estimated it can be used in

simulation studies of system behavior. To advance project work in the

estimation area the programs in the Lee, Judge and Zellner book were
debugged by a computer specialist (Ralph Bailey) at the University of
Birmingham. When tested on hypothetical control data the program was
found to estimate parameters properly.

One original estimation program named 'ESTTRAN' was developed
in 1979 by Mr. Bailey for my use in the project. (This work was not
funded by the National Council, however). For any matrix of Markov
chain transition probabilities the program calculates the fundamental
matrix (see pg. 37 above). The coefficients $N_{ij}$ of this matrix give
the mean number of time periods the average member of state $i$ will spend
in state $j$. In addition the program calculates the seven social indicators
associated with the Markov chain. (3:117-118)

1. $\tau = N \cdot \xi$, where $\xi$ is column unit vector. The row elements
   of column vector $\tau$ give the number of units (say years)
   of life a member of initial state $i$ can expect. (These
   interpretations of $N$ and $\tau$ illustrate the link between the
   fundamental matrix and the more traditional demographers tool,
   the life table).

2. $N_{2} = N(2N_{dg} - I) - N^{2}$, where $N_{dg}$ is the diagonal matrix of $N$.
   The $ij$ coefficients of this matrix indicate the variance of the
   number of years the average member of state $i$ will spend in
   state $j$ before absorption. (4:49-50)
3. $\zeta_2 = (2N-I) \cdot \zeta - \zeta^2$. This vector gives the variance of the state-specific expectations of life given in $\zeta$. (4:51)

4. $B = ND$, where $D$ is the absorption matrix. This shows the state-specific expectations of absorption. (4:52-53) Thus it is the complement of $\zeta$.

5. $TR = (N-I) \cdot N^{-1}_{dg}$ shows the probability that a member of $i$ will move to transient state $j$ during the history of the process. (4:61)

6. $ME_i = \frac{1}{(1-c_{ii})}$ measures the mean number of 'years' a member remains in transient state $i$ once that state is entered. (4:61)

7. $QS = \frac{c_{ij}}{(1-c_{ii})}$ shows the conditional probability of moving to transient state $j$ given that a member has left state $i$. (4:61)

This program was used successfully to estimate, using hypothetical data, these indicators for the 12x12 transition matrix of population reproduction specified in my dissertation. (3:158)

One final related topic of research was system simulation using the accounting model. Some progress has been made in this area. During winter 1980, outside the project period, I revised the accounting model and Mr. Bailey programmed a computer representation of the first two quadrants. This work was interrupted by my recent trip to the USSR. However, it should be completed in the near future.

4. Conclusions and Future Research

The accounting model of the health production process is still being developed at the conclusion of the National Council sponsored project (September 1980). The approach adopted appears to be of great
value and merits further attention. Progress has been made in the areas of model specification, data collection, estimation and system simulation. However, to date the revised model has not been estimated and tested. Therefore there are no concrete results from empirical analysis to be reported.

I plan to continue research in this area during the next academic year. In October 1980 a paper on the model will be presented at a conference in Poland of the Editorial Board of the journal, The Economics of Planning. Work will continue on improvement of the data base. This should enable estimation to begin next spring. Following that, efforts will be made to use the model for structural analysis and system simulation.
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PART IV: Econometric Modelling of the Soviet Health Production Process

1. Introduction

The health production process in the USSR was described in Section II of this report. Previous research by this author has identified a number of problems associated with it. One of the most serious is the rise in age-specific mortality rates and the accompanying decline in life expectancy. An important issue of concern to health policy makers is the responsibility of the health system for these unfavorable trends in mortality. In an attempt to clarify this issue, two Western models were estimated by econometric techniques using Soviet time series data for the period 1959-1976. This section of the report discusses the results of the econometric research carried out in summer 1980.

The econometric approach involves the use of economic models, data, and statistical techniques to estimate and evaluate relationships between economic variables. The estimated econometric model can then be used for structural evaluation, forecasting and policy evaluation.

The discipline of econometrics has developed rapidly in the past several decades. Many advances have been made in the specification of models, the collection and processing of data and the development of estimation techniques. Applications of econometrics have been made in most branches of economics. In recent years two areas relevant to the topic of this report have been analyzed by econometricians: health economics and Soviet economics.

Econometric models have been used by health economists since Feldstein's pioneering work was published in 1967. Most studies have
involved the estimation of single-equation models derived from neoclassical microeconomic theory.\(^{(14)}\) For example, there have been numerous estimates of cost curves of hospitals and of demand functions for medical services. Grossman, Fuchs, and others associated with the National Bureau of Economic Research have developed models for the health sector, which are based on the theory of human capital, and have used econometrics to estimate them.\(^{(1)}(13)\) Finally some simultaneous equation models of the whole health care system have been employed in econometric investigations.\(^{(14)}(23)\) However, little attention has been devoted to the analysis of the health production process at the national level.

Analysts of the Soviet economy have also turned to econometric models in the past 15 years. Initial research was concentrated on the estimation of sectoral and branch production functions.\(^{(16)}\) In the 1970s, however, there was a rapid expansion of econometric modelling.\(^{(15)}\) A serious effort has been made to create a macroeconometric model (SOVMOD) of the Soviet Union. The first variant of SOVMOD is described in the 1977 book of Green and Higgins.\(^{(12)}\) Subsequently this model and others have been further refined. Despite this, no effort has been made to econometrically examine the institution of health in the USSR.

Since econometric techniques have proved useful in both health and Soviet economics it seems likely that the same outcome would obtain in the field defined by their intersection: the economics of the Soviet health system. During the summer 1980 project period this author carried out initial econometric research in this area. Two western models were adapted to describe the health production process in the USSR. On the basis of published Soviet and Western data the parameters were estimated and econometric results discussed.
2. The Problem

One of the most important problems confronting Soviet health policy makers is that of rising mortality and falling life expectancy. The recent literature on mortality trends in the USSR suggests that few simple solutions exist. From the description of the health production process presented above in section II it should be clear that the mortality output is the joint product of illness pattern and curative medicine variables. Until now, though, no attempt has been made to determine, through the use of quantitative methods, the relative influences of these two factors on mortality/life expectancy and the consequences for Soviet policy in the health sector. In this section of the report an attempt is made to employ econometric techniques to address this issue.

3. The Models

Section II of the report on the Soviet health system to the National Council for Soviet and East European Research argued that health output (H) is a function of illness pattern (IP) and medical services (MS)

\[ H = h(IP, MS) \]

The precise shape of this function varies according to the variables chosen and assumptions about the nature of their interaction.

One simple model of health production would be the linear one

\[ H = A + \beta_1 IP + \beta_2 MS \]

where \( A = \) constant

\( \beta_1, \beta_2 = \) coefficients

In this case A measures the intercept of the H axis. The coefficients which are the partial derivatives of the H function
\[ \beta_1 = \frac{\partial H}{\partial IP}, \quad \beta_2 = \frac{\partial H}{\partial MS} \]

Measure the marginal contributions to health of changes in illness pattern and medical services.

An alternative simple model of health production is the multiplicative one

\[ H = A \cdot IP^{\sigma_1} \cdot MS^{\sigma_2} \]

where \( A, \sigma_1, \) and \( \sigma_2 \) are constants.

The parameters \( \sigma_1, \sigma_2 \) can be determined as follows

\[ \frac{\partial H}{\partial IP} = A(\sigma_1) \cdot IP^{\sigma_1 - 1} \cdot MS^{\sigma_2} \]

\[ \sigma_1 = \begin{bmatrix} \frac{\partial H}{\partial IP} \\ \frac{\partial H}{\partial MS} \end{bmatrix} \begin{bmatrix} \frac{1}{\sigma_1 - 1} \\ \frac{1}{\sigma_2} \cdot MS \end{bmatrix} = \begin{bmatrix} \frac{\partial H}{\partial IP} \\ \frac{\partial H}{\partial MS} \end{bmatrix} \frac{IP}{A \cdot IP^{\sigma_1} \cdot MS^{\sigma_2}} \]

\[ = \begin{bmatrix} \frac{\partial H}{\partial IP} \\ \frac{\partial H}{\partial IP} \end{bmatrix} \frac{IP}{H} \]

Similarly,

\[ \sigma_2 = \begin{bmatrix} \frac{MS}{H} \end{bmatrix} \begin{bmatrix} \frac{\partial H}{\partial MS} \end{bmatrix} \]

These of course are measures of the elasticity of the output \( H \) with respect to the inputs \( IP, MS \).

It was shown above in section II that the health production process is more complex. To enrich the simple models one can recognize that \( IP \) and \( MS \) are themselves functions of other variables:

\[ IP = g(HS, C, E) \]

\[ HS = \text{health stock} \]
C = consumption
E = environment
MS = f(MM, CS, S)
MM = medical manpower
CS = health facilities
S. = health commodities

It is now possible to express health output in terms of the other variables. Substituting one obtains

\[ H = h(g(HS, C, E), f(MM, CS, S)) \]

As above the character of the production function is dependent upon assumptions. Assume once more that we have a linear system.

\[ H = A_1 + \beta_1 IP + \beta_2 MS \]
\[ IP = A_2 + \alpha_1 HS + \alpha_2 C + \alpha_3 E \]
\[ MS = A_3 + \gamma_1 MM + \gamma_2 CS + \gamma_3 S \]

Substituting

\[ H = A_1 + \beta_1 (A_2 + \alpha_1 HS + \alpha_2 C + \alpha_3 E) \]
\[ + \beta_2 (A_3 + \gamma_1 MM + \gamma_2 CS + \gamma_3 S) \]
\[ = A_1 + \beta_1 A_2 + \beta_1 \alpha_1 HS + \beta_1 \alpha_2 C + \beta_1 \alpha_3 E \]
\[ + \beta_2 A_3 + \beta_2 \gamma_1 MM + \beta_2 \gamma_2 CS + \beta_2 \gamma_3 S \]
\[ = A_1 + \beta_1 A_2 + \beta_2 A_3 + \beta_1 \alpha_1 HS + \beta_1 \alpha_2 C + \beta_1 \alpha_3 E \]
\[ + \beta_2 \gamma_1 MM + \beta_2 \gamma_2 CS + \beta_2 \gamma_3 S \]

let

\[ A'_1 = A_1 + \beta_1 A_2 + \beta_2 A_3 \]
\[ \beta'_1 = \beta_1 \alpha_1 \]
\[ \beta'_2 = \beta_1 \alpha_2 \]
\[ \beta'_3 = \beta_1 \alpha_3 \]
\[ \beta'_4 = \beta_2 \gamma_1 \]
\[ \beta'_5 = \beta_2 \gamma_2 \]
\[ \beta'_6 = \beta_2 \gamma_3 \]
then

\[ H = A'_1 + \beta'_1 HS + \beta'_2 C + \beta'_3 E \]
\[ + \beta'_4 MM + \beta'_5 CS + \beta'_6 S \]

So \( H \) is a linear function of the new exogenous variables.

An alternative non-linear model can be derived from the multiplicative function given above. Assume

\[ H = A_1 IP^\sigma_1 MS^\sigma_2 \]
\[ IP = A_2 HS^\sigma_3 C^\sigma_4 E^\sigma_5 \]
\[ MS = A_3 MM^\sigma_6 CS^\sigma_7 S^\sigma_8 \]

Then by substitution

\[ H = A_1 (A_2 HS^\sigma_3 C^\sigma_4 E^\sigma_5)(A_3 MM^\sigma_6 CS^\sigma_7 S^\sigma_8) \]
\[ = (A_1A_2A_3)(HS^\sigma_3 C^\sigma_4 E^\sigma_5 MM^\sigma_6 CS^\sigma_7 S^\sigma_8) \]

let

\[ A'_1 = A_1A_2A_3 \]

then

\[ H = A'_1 HS^\sigma_3 C^\sigma_4 E^\sigma_5 MM^\sigma_6 CS^\sigma_7 S^\sigma_8 \]

Again, the health output variable is a function of the exogenous variables of the illness pattern and medical service functions.

One can, of course, develop an even richer model by taking into account the dependence of the six current exogenous variables on others. From section II of this report it is clear that the variables HS, C and E, as well as the input variables of the medical services function, are determined by a complex interaction of other factors. For example, the health stock depends upon age, sex, genetic and historical experience variables. By expressing these dependencies in mathematical form and
substituting as above a revised, more complicated model is determined.

In practice, the choice of degree of complexity is often determined by
the availability of data. With respect to the Soviet health production
this issue is discussed in the following section.

Two models were specified to carry out the first econometric
investigations of health production. The first of these is linear and is
in the spirit of the one proposed by Dutton in his analysis of recent
Soviet mortality trends.\(^{(7)}\) This author hypothesized that variation in
regional-level crude mortality rates was a linear function of variables of
alcohol consumption, age, sex, education, population density, rural
population share, provision of doctors and nationalities. A weighted
least squares procedure was used to estimate parameters.

In order to test the utility of the linear model in describing
health production in the USSR a function was chosen of the form

\[
H = A + \sum_{j=1}^{M} \beta_j M_j + \sum_{j=M}^{N} \rho_j X_j + \epsilon
\]

where

- \(H\) = health output
- \(A\) = constant
- \(\beta_j\) = coefficients
- \(M_j\) = medical service variables (\(j = 1 \ldots m\))
- \(X_j\) = health condition variables (\(j = m \ldots n\))
- \(\epsilon\) = random error term

The precise nature of the variables and the data used in estimation is
described below.
The second model has a multiplicative production function. A model of this type was used by Auster et al. to analyze variation across states in the U.S. of age-sex-adjusted mortality rates.¹ Their model was of the form described above.

\[ H = A \cdot M^{\sigma_0} \cdot \prod_{j=1}^{q} X_j^{\sigma_j} \cdot e \]

where

- \( H \) = age-sex-adjusted mortality
- \( A \) = constant
- \( M \) = medical expenditure per capita
- \( \sigma_0 \) = elasticity of \( H \) with respect to \( M \)
- \( \prod \) = multiplicative index
- \( X_j \) = health environment variables
- \( e \) = exponential
- \( \epsilon \) = random error term.

A logarithmic transform was used to put this function into linear form

\[ \ln H = a + \sigma_0 \ln M + \sum_{j=1}^{q} \sigma_j \ln X_j + \epsilon \]

where \( a = \ln A \)

The method of two-stage least squares was then used to estimate the constant and the elasticities.

A multiplicative model very similar to that of Auster et al. was specified for the health production process in the USSR. The variables chosen are described in the next section.
4. **Choice of Variables and Availability of Data**

To estimate the parameters of the two models measurable endogenous and exogenous variables must be chosen and appropriate data gathered. Given the limited information published in the U.S.S.R. the selection of model variables inevitably involves compromise. This section discusses the choices made and presents the data used.

The problem under investigation is that of explaining rising mortality (or falling life expectancy) over the period 1959-76 in the USSR. The appropriate data for estimating the models are therefore time series. However, it would be of interest at a later date to analyze regional mortality variations using cross-section data.

The variables for which time series data are desired are those associated with health output, illness pattern and medical services.

**Health Output** Several mortality-based indicators were considered as candidates for the output indicator: crude mortality, age-sex-specific mortality, life expectancy, sex-specific life expectancy. It was decided that the best dependent variable for this investigation would be male life expectancy. Data for the years 1959-1969 were obtained from a published U.S. Bureau of the Census document. Supplemental information was obtained directly from Godfrey Baldwin. The series is shown in column 2 of Table 1.

**Medical Services** Ideally one would like a variable which measures the output of a medical service production function. In natural terms this could be a weighted index measure of provision of bed-days and outpatient consultations. Alternatively Auster et al. chose as a summary variable expenditures on medical care. To date the necessary production function
<table>
<thead>
<tr>
<th>Year</th>
<th>Male Life Expectancy (years)</th>
<th>Number of Doctors per 10,000 Population</th>
<th>Annual per Capita Meat Consumption</th>
<th>Net of Population Over Age 50 with Higher Education</th>
<th>Total Cigarettes and Alcohol Produced (billions)</th>
<th>Alcohol as % of Total Volume</th>
<th>Total Population Living in Urban Areas</th>
<th>Total Population Living in Rural Areas</th>
<th>Net Family Formation (Marriages per 1,000)</th>
<th>Index of Production (1956-59 = 1.00)</th>
<th>Annual Production of Motor Vehicles (thousands)</th>
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<tr>
<td>1959</td>
<td>64.4</td>
<td>17.9</td>
<td>39**</td>
<td>361</td>
<td>243.4</td>
<td>5.09</td>
<td>8.3</td>
<td>48</td>
<td>11.1</td>
<td>7</td>
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<td>65.9</td>
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<td>39*</td>
<td>368</td>
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<td>8.6</td>
<td>49</td>
<td>10.8</td>
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<td>8.9</td>
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<td>21.5</td>
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<td>6.60</td>
<td>9.5</td>
<td>52</td>
<td>7.0</td>
<td>14</td>
<td>603</td>
</tr>
<tr>
<td>1965</td>
<td>66.2</td>
<td>23.9</td>
<td>41</td>
<td>423</td>
<td>304.0</td>
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<td>9.7</td>
<td>53</td>
<td>7.1</td>
<td>15</td>
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<td>44</td>
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<td>10.4</td>
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<td>27.4</td>
<td>48</td>
<td>483</td>
<td>324.0</td>
<td>9.52</td>
<td>10.8</td>
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<td>7.1</td>
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<tr>
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<td>11.0</td>
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<tr>
<td>1972</td>
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<td>29.5</td>
<td>52</td>
<td>509</td>
<td>348.0</td>
<td>10.08</td>
<td>11.2</td>
<td>58</td>
<td>6.8</td>
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<tr>
<td>1973</td>
<td>64.4</td>
<td>30.6</td>
<td>53</td>
<td>522</td>
<td>362.0</td>
<td>9.67</td>
<td>11.4</td>
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<td>7.4</td>
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<tr>
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<td>537</td>
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<td>11.7</td>
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<tr>
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<td>56</td>
<td>569</td>
<td>372.2</td>
<td>11.70</td>
<td>11.9</td>
<td>61</td>
<td>6.7</td>
<td>47</td>
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</tr>
</tbody>
</table>

**Sources of Data:**
- 1959-69: Ref. 18: 2:14
- 1963: Ref. 18: 1065-597
- 1964: Ref. 18: 1967-697
- 1970: Ref. 18: 1968-596
- 1976: Ref. 18: 1969-583
- Personal Communication of G. Baldwin 1978-592
- Ref. 18: 1978-78: 1972-186
- Ref. 18: 1972-133
- Ref. 18: 1975-195
- Ref. 18: 1978-120

*Interpolated
**Extrapolated
analysis of the health sector has not been carried out. Accordingly a proxy variable was chosen: the number of doctors per 10,000 population (See column M of Table 1). Since this indicator is of fundamental importance in Soviet health planning, its trends probably reflect those of the health system in general. It is therefore an acceptable variable for these first econometric exercises.

**Illness Pattern** In section II.2 of this report trends in Soviet health conditions and the illness pattern are surveyed. It is noted there that there has been insufficient analysis of the structure of Soviet illness and therefore summary variables are unavailable. To continue the quantitative analysis one must assume that the illness pattern is a linear or multiplicative combination of health stock, consumption and environmental variables, and then attempt to gather data on these secondary variables. This strategy was adopted for the project work.

**Health Stock** Because the output indicator is male life expectancy neither age nor sex distribution variables are relevant. It was assumed that there were no significant changes in genetic stock and that historical experience variables were neutral. Thus there are no health stock variables in the model.

**Consumption** Conventional economic measures of income and consumption were eliminated from consideration as variables because they do not express the ambiguity of the consumption-health status relationship. Both positive and negative health effects should be included in any model. To this end the four consumption variables shown in Table 1 were chosen. Per capita meat consumption \((X_1)\) reflects the improvement in the average Soviet diet over the past two decades. The rise in the general educational
standard of the population, measured by $X_2$, should also exert a beneficial impact on health status. On the other hand, cigarette smoking and drinking alcohol are unhealthy habits. The time series of variables $X_3$ and $X_4$ suggest that both forms of consumption have significantly increased.

**Environment** No adequate summary indicators of the health environment in the USSR are given. Again one must consider the variables determining the values of the environmental influence function in order to find published data.

The environment was shown above to consist of five dimensions. In the models of this study the residential environment is measured by housing space per capita ($X_5$) and per cent urban population ($X_6$). Trends in the family health environment are assumed to be reflected by the rate of net family formation. In this case there is little doubt that one could think of better variables, but for few of the alternatives would one be able to find published data.

Section II.2.d argued that the rapid mechanization of Soviet society and the rapid growth in chemical and automobile production are having adverse health consequences for the population. Variables $X_8$ and $X_9$ are assumed to measure important developments in the technological and natural environments. One would expect the large increases in both indicators to undermine health status.

One approach to measuring the influence of the microbiological environment would be to use a dummy variable for influenza epidemics. It was decided, however, to assume that no significant changes had occurred in this dimension. Given this it was not necessary to specify a microbiological variable.
Examination of the time series data in Table 1 reveals that trends in most variables are similar, presumably reflecting the general economic and social development of the USSR over the period 1959-76. Ideally one would want to 'smooth' these series, using various adjustment techniques, before estimating parameters. However, time constraints of the project did not allow this additional work to be done. Therefore the estimation was based on unadjusted data.

5. Estimation of the Models and Econometric Results

With the general forms of the models and the variables chosen, and the data gathered, it is possible to proceed with estimation. The two models to be estimated are:

\[ (1) \quad H = A + \beta_0 M + \sum_{j=1}^{9} \beta_j X_j + \varepsilon \]

The data on the endogenous variable (H) and the exogenous ones (M, X_j) are given in Table 1.

From the multiplicative model

\[ H = AM \prod_{j=1}^{9} X_j \sigma_j e \]

the logarithmic one is derived.

\[ (2) \quad \ln H = a + \alpha_0 \ln M + \sum_{j=1}^{9} \alpha_j \ln X_j + \varepsilon \]

The data on these variables is obtained by taking the logarithms of the time series in Table 1.

The usual degrees of freedom and rank assumptions about the linear equations are made. These require that the number of data points be greater than that of the parameters to be estimated and that the explanatory variables be linearly independent. With respect to the error term it is assumed to be normally distributed with zero mean, stable finite variance (homoskedasticity) and zero covariances (absence of serial correlation).
Estimation was carried out using CORR, GLM and SYSREG programs from SAS (Statistical Analysis System).* The computational work was done at the Harvard University Computing Center in September 1980.

The first step involved estimation of correlation coefficients between variables. The results for equation (1) are shown in Table 2 (The correlation matrix for the variables in logarithmic form is approximately the same):

Table 2: Correlation Coefficients of Variables in Model (1)

<table>
<thead>
<tr>
<th>Variables</th>
<th>H</th>
<th>M</th>
<th>X1</th>
<th>X2</th>
<th>X3</th>
<th>X4</th>
<th>X5</th>
<th>X6</th>
<th>X7</th>
<th>X8</th>
<th>X9</th>
</tr>
</thead>
<tbody>
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<td>-.81</td>
<td>-.74</td>
<td>-.68</td>
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<td>-.80</td>
<td>-.82</td>
</tr>
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<td>.97</td>
<td>.98</td>
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<td>.99</td>
<td>.99</td>
<td>-.62</td>
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<td>.93</td>
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<tr>
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<td>.93</td>
<td>.96</td>
<td>.96</td>
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<td>.94</td>
</tr>
<tr>
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<td>.97</td>
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<td>.93</td>
</tr>
<tr>
<td>X3</td>
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<td>.93</td>
<td>.96</td>
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<tr>
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<td>1.00</td>
<td>.99</td>
<td>-.64</td>
<td>.98</td>
<td>.92</td>
</tr>
<tr>
<td>X7</td>
<td>.02</td>
<td>-.62</td>
<td>-.48</td>
<td>-.61</td>
<td>-.57</td>
<td>-.64</td>
<td>-.66</td>
<td>-.64</td>
<td>1.00</td>
<td>-.51</td>
<td>-.34</td>
</tr>
<tr>
<td>X8</td>
<td>-.80</td>
<td>.98</td>
<td>.97</td>
<td>.99</td>
<td>.96</td>
<td>.97</td>
<td>.97</td>
<td>.98</td>
<td>-.51</td>
<td>1.00</td>
<td>.97</td>
</tr>
<tr>
<td>X9</td>
<td>-.83</td>
<td>.93</td>
<td>.94</td>
<td>.93</td>
<td>.91</td>
<td>.89</td>
<td>.90</td>
<td>.92</td>
<td>-.34</td>
<td>.97</td>
<td>1.00</td>
</tr>
</tbody>
</table>

It shows that virtually all variables are highly correlated, with the exception of X7 (family formation). This confirms the impressions based upon visual inspection (pg. 62) and points to the necessity of adjusting the series to remove 'social progress' trends. Analysis of the relationships between variables also suggests the existence of multicollinearity. For example the growth in automobile production (X9) has undoubtedly caused an increase in the output of

petroleum products (X8). Thus these two variables are not independent. Other causal relationships probably exist between alcohol consumption (X4) and family formation (X7) and between urbanization (X6) and educational standards (X2). Indirect causal links may also exist which would produce correlated movements in time series. The development of agriculture obviously affects per capita meat consumption (X1), cigarette production (X3) and alcohol consumption (X4). Similarly, the expansion of Soviet industry strongly influences variables X5, X8 and X9. Thus the correlation analysis raises questions not only about the use of unadjusted data, but also about the specification of the model.

The results of the econometric estimations are shown in Table 3:

Table 3: Econometric Estimates of the Parameters of Models (1) and (2)

<table>
<thead>
<tr>
<th>Model</th>
<th>H = A + \sum \beta_j X_j + \epsilon</th>
<th>Model</th>
<th>\ln H = a + \sum \sigma_j \ln X_j + \epsilon</th>
</tr>
</thead>
<tbody>
<tr>
<td>R^2</td>
<td>.94</td>
<td>R^2</td>
<td>.95</td>
</tr>
<tr>
<td>Variable</td>
<td>Parameter Estimate</td>
<td>Standard Error</td>
<td>t Ratio</td>
</tr>
<tr>
<td>Intercept</td>
<td>77.54</td>
<td>17.59</td>
<td>4.41</td>
</tr>
<tr>
<td>M</td>
<td>.60</td>
<td>.41</td>
<td>1.48</td>
</tr>
<tr>
<td>X1</td>
<td>.15</td>
<td>.15</td>
<td>1.02</td>
</tr>
<tr>
<td>X2</td>
<td>-.06</td>
<td>.05</td>
<td>-1.15</td>
</tr>
<tr>
<td>X3</td>
<td>.01</td>
<td>.01</td>
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</tr>
<tr>
<td>X4</td>
<td>-.75</td>
<td>.70</td>
<td>-1.06</td>
</tr>
<tr>
<td>X5</td>
<td>-.08</td>
<td>1.54</td>
<td>.05</td>
</tr>
<tr>
<td>X6</td>
<td>-.02</td>
<td>.42</td>
<td>-.06</td>
</tr>
<tr>
<td>X7</td>
<td>-.47</td>
<td>.25</td>
<td>-1.86</td>
</tr>
<tr>
<td>X8</td>
<td>.11</td>
<td>.26</td>
<td>.45</td>
</tr>
<tr>
<td>X9</td>
<td>-.003</td>
<td>.003</td>
<td>-.85</td>
</tr>
</tbody>
</table>
The $R^2$ statistic, a measure of total variation explained by the model, is high in both cases: 0.94 and 0.95. The F tests show that the hypothesis that all coefficients are zero can be rejected with a very high level of confidence. However, these results are not meaningful in isolation. To properly evaluate the adequacy of the estimated model the parameters must be examined closely.

The estimated parameters are shown in columns 2 and 6. The signs of six out of the ten parameters are as expected. The variable $M$ (doctors per 10,000) has a positive influence on life expectancy whereas alcohol consumption has a negative effect. Looking further, though, it is evident that the standard errors are relatively large and the t-ratios small. Consequently the t-tests of the parameter estimates do not show them to be statistically significant.

This outcome, in conjunction with the high $R^2$ for the model as a whole, indicates the presence of multicollinearity. To correct this problem would require re-specification of the models, removing linearly dependent variables, as well as data supplementation.

Questions about the specification of the model and the influence of unobserved variables suggest that the assumption of independent stochastic disturbance terms may not be justified. Therefore the Durbin-Watson test for serial correlation was carried out. The Durbin-Watson statistics are 2.71 for the linear model and 2.57 for the log-linear one. These values indicate the presence of negative first-order serial correlation. To treat this problem one would want to redefine the model so that possible hidden explanatory variables were included.

In light of the linear dependence of some variables in the model one final econometric exercise was to employ stepwise linear regression to find the most parsimonious model. The SAS STEPWISE program with option MAXR (maximum $R^2$ improvement) was used. This shows that a five variable model could be chosen with an $R^2$ of 0.93 in the linear case and 0.92 in the log-linear.
The econometric evaluation of the estimated model reveals that little confidence can be placed in the parameters. Therefore any attempt to analyze the structure of the Soviet health production process using these estimates would be speculative and ill-founded. Additional research clearly must be done in the areas of data collection and treatment, and of model construction. However, the project period ended before this supplemental work could be accomplished. Econometric modelling of the health production process in the USSR will undoubtedly become a component of a future research program.

6. Summary and Conclusions

During summer 1980 research commenced on econometric modelling of the Soviet health production process. Previous health economics literature was examined and two models of life expectancy determination were chosen. Available Soviet time series were surveyed and measureable explanatory variables identified. Data were gathered from various sources and parameters of the models estimated. Although statistical evaluation of the econometric results indicates several problems with these first variant models, the theoretical approach appears to be sound. Therefore work will continue in this area. An attempt will be made to build upon the research foundation laid during the period of my participation in the National Council project and to eventually develop a reliable econometric model of the Soviet health sector which can be used for structural analysis, projection and policy evaluation.


18. Tsentral'noye Statisticheskoye Upravleniye SSSR Narodnoye khozyaistvo SSSR v .... Moscow, Statistika, Various years.


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