

Appropriation Testimony

A Different Perspective

Familiar ills which dominate the headlines
The budget deficit
The trade deficit
Displaced workers
Marginal Industries
The meltdown of the stock market
The bad news for Michigan is obvious...
Industries of great economic importance to our nation such as steel and automobiles have fallen victim to intense competition from abroad...
Plants have closed...our cities are filled with chronically unemployed...
In Michigan we no longer worry about nuclear war and the bomb because we believe that
"The odds are greater that America will be bought up by the Japanese than blown up by the Russians..."

What is happening?

- 1) INTERNATIONALIZATION OF AMERICA
Market for nearly all significant manufacturing industries has become worldwide
Jack Welch, CEO of GE, noted last November:
"Within the next 2 to 3 years, at most, the most important alliances will be forced in every significant global industry--medical, autos, defense, materials, and so on. Those who are slow to recognize the emergence of these global alliances or to act in forming them will find themselves locked out of the game as we enter the 1990s."
- 2) DRAMATIC CHANGES IN THE STRUCTURE OF OUR ECONOMY
Industrial production is steadily switching away from material and labor intensive products and processes to knowledge intensive processes:
In a car, 40% materials, 25% labor...
In a chip, 1% materials, 10% labor, 70% knowledge!!!
Increasing manufacturing production has come to mean decreasing blue collar employment!
In the 1920s, 1 of 3 was a blue-collar worker today 1 in 6 and dropping fast probably to about 1 in 20 by 2000...

THE CHALLENGE OF DRAMATIC ECONOMIC CHANGE

Traditional industry economy is shifting to a new knowledge-based economy, just as our industrial economy evolved from an agrarian society at the turn of the century.
A transition is occurring in which..
Intellectual capital has replaced financial and physical capital as key to economic development
In all developed countries, "knowledge" workers have already become the center of gravity of the labor force.
As Erich Bloch, Director of the National Science Foundation puts it, we have entered a new age, an "Age of Knowledge in a Global Economy"
The challenge today is to develop an agenda to achieve and sustain prosperity in a new environment of intense international competition and rapid technological change.

The Age of Knowledge in a Global Economy

Tremendous new industries have been created by new technical knowledge: electronics is the obvious example of the last three decades; biotechnology may be the

example for the coming three decades.
These industries depend on knowledge as the most critical resource.
But knowledge is highly mobile...it is not tied to geographic regions as coal or iron or oil.
By contrast, the knowledge revolution is happening worldwide and at a very rapid rate.
The handwriting is on the wall...
Taxes, trade, and fiscal policies influence economic competitiveness. But in the long run, a strong base of science and engineering research and education is more important.
Maintaining America's competitive edge requires attention to our traditional strength -- people and research -- and a strong offensive strategy based on these resources.
People -- not equipment or buildings -- are the source of creativity.
They generate the knowledge that makes the technological innovation possible. They are the workforce that makes society run.

Clouds on the Horizon

WARNING SIGN 1: America is slipping

No question that US has lost lead in many areas
Industrial productivity and heavy manufacturing
Steel, durable goods, ...

Energy
Electronics

Also serious signs that lead is slipping rapidly in
Computers
Aerospace

Moreover, key activities such as product design, engineering, and software development increasingly are likely to be done overseas.

Whether automobiles or refrigerators, computers or microchips, nuclear power or energy transmission systems, the likelihood is increasing that the systems are assembled from components designed, engineered, manufactured, and shipped from all parts of the world.

WARNING SIGN 2: We are seriously underinvesting in R&D and Education

For over two decades, US investment in civilian R&D has dropped while that of our competitor nations has risen rapidly. We are now far behind Japan and Germany in the fraction of GNP invested in R&D.

WARNING SIGN 3: S&E Manpower Shortage

US faces a S&E manpower crisis of unprecedented proportions

0. Indeed, today the United States awards the smallest proportion of university degrees in science and engineering of any industrialized nation!
1. Proportion of graduating seniors who major in science and engineering is smaller today than it was in 1970s (5%). Particularly severe drops in physical sciences and mathematics. (Fallen by 40% over past decade)
2. Per capita production of US engineers lowest among industrialized nations:
President of Sony:
"In US you produce 4 lawyers for every engineer.
In Japan, we graduate 4 engineers for every lawyer!"
3. More than 60% of engineering PhDs are now foreign
Indeed, foreign students account for nearly 85% of growth.

It is bad policy to be dependent on an unpredictable resource and not to be able to meet more of our needs with American talent. But things are going to get MUCH rougher: NSF Study

Supply will probably fall off dramatically

Traditional source of S&E college students is declining

25%-30% falloff in HS graduates by 1992

Assuming that same fraction (4.8%) choose to enter S&E, and assuming constant demand (very conservative), there will be a cumulative shortfall of 700,000 by 2010!

Note: Composition of college age population is also changing...

By 2020 30% will be composed of Blacks and hispanics...

students who have not traditionally chosen S&E careers.

The fastest growing pool of youths has the lowest participation rate in college and the highest dropout rate in high schools -- not to mention the least likelihood to study science and math.

Indeed, while Blacks and Hispanics account for 20% of total population, they account for less than 2% of scientists and engineers!

NOTE: We must make special efforts to expand participation by these groups...not just because that is good social policy, but because we cannot afford to waste their talents!

WARNING SIGN 4: Labor force of Michigan is becoming obsolete!

Michigan is undergoing dramatic change in industry...

Away from low-skill, blue-collar workers

The factory of the future will have NO low skill workers

Unskilled labor will lose relevance in a world dominated by microelectronics, computers, and automation.

An example: Expert systems

The "expert system" craftsman...

Serious concern:

1. The present generation of blue-collar workers does not have the formal education to be retrained!!!
2. Little sign that education system is adapting to this future.

It is bad enough to face the prospect of a significant fraction of our labor force becoming permanently unemployable because of an inadequate education. Do we want to condemn their children...OUR children...to a similar fate? Can we afford it?

The State of Michigan Response

What has been the response of Michigan to the challenge of change -- to the Age of Knowledge in a Global Economy...

As we look to the knowledge-intensive future of Michigan, we recognize as have so many other states that it will be our great research universities that will hold the key to our collective prosperity.

Importance of Research Universities

Importance of world-class research universities

Look around:

New England: --> MIT

Bay area-Silicon Valley --> Stanford & UCB

Southern California --> Caltech

Astin --> U. Texas

Why?:

Through research produce knowledge necessary for competitiveness

Produce talented professionals to implement new knowledge

Attract "risk capital" through massive federal R&D support

Key to knowledge transfer

Traditional: graduates, publications

Entrepreneurs
 Startups
 Development of Unique State-University Partnership
 Universities committed themselves to:
 Strategically realigning activities into key thrust areas
 of major importance to State...
 Attracting leading scientists, engineers, and professionals
 to staff these programs...
 Developing new mechanisms for technology transfer...
 State government committed itself to:
 Establishing higher education in general and the state's
 research universities as a high priority
 Providing seed resources to sustain key thrust areas
 Developing novel institutions to act as catalysts in these activities

University of Michigan Actions

Key:

Began to think and act strategically...how to better position ourselves

Hence, we chose as our thrust areas...

Complex manufacturing systems
 Machine Intelligence
 Advanced electronics and optics technology
 Information Technology

Other steps

1. Recruiting key engineers and scientists
2. Modifying ways we interact with outside world...
 Strengthened interactions with industry
3. Intellectual property policies
4. Michigan Information Technology Network...

Cultural Changes

Reaffirmation of the importance of individual achievement,
 of excellence...We have once again recognized the ability
 of talented people to do great things -- if we will only
 get out of their way and let them!

Importance of establishing an intense, entrepreneurial
 environment...a no-holds barred, go-for-it culture...in
 which individual initiative, achievement, and the quest
 for excellence are dominant elements

Already clear evidence of payoff...

NOTE: These should be redone with more of a regional flavor...

Already clear evidence of payoff...

0. Research Excellence Fund has created nationally recognized centers in:
 - Complex manufacturing technology
 NSF believes we now have best faculty in nation in these areas
 - Machine intelligence
 - Advanced electronics
 - Information technology
 - These programs already have attracted three major national research
 centers funded at \$40 M.
1. Semiconductor Research Corporation
 Center of Excellence in Electronics Manufacturing
2. DOD URI Center of Excellence
 UM captured the lions share: \$20 M
 Governor's dedication of the most sophisticated
 solid state electronics laboratory in the nation...
 focused on optoelectronics -- the fusion of
 electronics and optics...
3. National Center for Manufacturing Sciences
 \$50 million per year
4. NASA Center for Space Commercialization
5. EXPRES
 UM is lead contractor, with Carnegie Mellon,

Stanford, MIT, and Berkeley

6. NSFnet
Bringing the knowledge of the world to Michigan
(MITN will play a key role in this...)
7. SSC...
8. Confidence in University, buoyed by the new priority given by higher education by the state, have enable use to attract to our faculty many of the world's leading scholars and teachers, scientists and engineers.
9. And, at the same time, the University has continued to leverage the state's investment, attracting \$2 from outside the state for every \$1 in state appropriation. Moreover, activities of our graduates and applications of our reserach have an impact on state's economy that totals in the billions of dollars.

Importance of staying the course...

The renewed investment in higher education of recent years has taken extraordinary vision, courage, and determination on the part of state government, particularly during a period with many other competing demands and pressures.

However, it also seems clear that in the knowledge-intensive future that our state faces, we really have no choice but to sustain and increase these investments.

In the long run it will be our investmentgs in the most important resources of all, in people and ideas, that will determine the future prosperity and well-being of our state.

UM Budget

Since the birth of our state 150 years ago, there has been a strong bond between the people of Michigan and their university, the University of Michigan.

Generation after generation of Michigan citizens have reaffirmed their commitment to provide in Ann Arbor an institution capable of:

- providing to their sons and daughters an education equal to the best
- attracting to Michigan the most outstanding scholars, scientists and engineers, doctors, lawyers, and teachers, and other professions so essential to our prosperity and well-being
- creating through its research and scholarship the new knowledge so necessary to economic growth and development
- addressing through a myriad of public service activities the many challenges facing our state.

This sustained public investment and confidence in the University over the years has enable it to serve the state in all of these ways and more.

Through this unique partnership, the University and its activities in education, research, and public service have served our state and its citizens well.

Today our state faces new challenges that will call once again on the vast resources of its University.

1. Michigan faces a period of dramatic economic change, during which it must evolve from a resource-intensive to a knowledge-intensive economy, in which intellectual capital will replace financial and physical capital as the key to economic development and prosperity. Our state will become ever more dependent on

key knowledge resources such as the UM as it faces the challenge of intense competition and rapid technological change, as it enters the age of knowledge in a global economy that will be its future.

2. Michigan also faces the challenge of providing to all peoples, regardless of race, creed, or national origin, the opportunity to participate in a future of prosperity and fulfillment.

Here, too, the UM must play a critical role, in reaching out to underrepresented minorities and other groups facing inequities in our society and providing them with the opportunity for full participation.

This demands a renewed commitment to increase the participation of those racial, ethnic, and cultural groups not adequately represented among our students, faculty, and staff.

The University must serve as a model in its effort to build a multicultural, pluralistic community on its campus which achieves new levels of understanding, tolerance, and mutual fulfillment for peoples of diverse backgrounds.

3. The University will also be a key in address the particular needs and concerns of impoverished areas throughout our state.

It intends to focus its considerable resources in the social sciences and professions on the problems faced by Michigan's cities.

It intends to use its vast resources in basic and applied science to develop and transfer the new technologies capable of economic development and growth to all regions of the state, from the metropolitan Detroit area to the Upper Peninsula.

The University views itself as a partner with state government, business, industry, and labor in addressing the needs of the State of Michigan.

Costs of a College Education

UM Financial Aid

Roughly 65% to 75% of students

Scholarships: \$56 million

Loans: \$30 million

Employment: \$31 million

Total financial aid: \$117 million

(Total tuition paid: \$190 million)

The Costs

- i) From 1970-71 to 1986-87, tuition nationwide has risen at an average rate of 7.8%, while the CPI rose at 6.7%
- ii) Bill Massey (Stanford) has published studies that demonstrate that the costs of college operations should generally increase 1.5% to 2.0% faster than the CPI on the average.
- iii) Two decades ago, Bill Bowen (Princeton) noted that "There are inexorable forces pushing up costs in education. The reason is simple: there is no way to mechanize teaching, dance, sculpture, and the like. If a field fails to keep pace with general productivity gains, then its products become

relatively more expensive."

- iv) Because most institutions failed to raise tuitions adequately in the 1970s, they are being forced to raise them more rapidly in the 1980s to make up for lost ground.

The Ability to Pay for a College Education

- i) Tuition increases are NOT increasingly dramatically faster than disposable personal income. Over the past 15 years, tuition has increased 232% while personal income has risen 253%.
- ii) Over the past two decades there has been very little change in the percentage of income required to meet tuition costs.
- iii) Indeed, college expenses have risen far more slowly than many other costs, such as the costs of a new home or the costs of health care.

The Willingness to Pay:

"The issue is not the ability to pay. The issue is the willingness to pay. There was a time when families would make major sacrifices to pay for children's college education. Major purchases were put on hold. Vacations were delayed. Mothers went back to work, or a father got a second job. The available evidence shows that the ability to pay for a college is more or less the same. But apparently the willingness is not."
NY Times, 5/12/87

Faculty Workload

Typical workload:

2-3 courses per term...6 - 9 hours in class...
+10 - 20 hours per week preparation and student hours
Graduate student supervision: 5 hours
Surveys: 50% instruction, 25% administrative, 25% research
65 to 70 hours per week of effort

Other measure:

- i) FYES/FTE are quite competitive
- ii) By most measures, FYES/FTE, \$/FYES, ... UM is one of the most efficient research universities in the nation

Nonresident

Regents have approved a plan to shift over next several years...

Research Excellence Fund

Enormous value to state...

Great payoff

Great national visibility

Don't mess with it...

Irony: at the time when we are going after major plums like SSC, now is not the time to tinker with the key investment which has given us the capacity to do this

New Facilities funds

In times of limited resources, it seems the best policy to allocate limited resources in as flexible a fashion as possible in an across-the-board manner and allow institutions to prioritize

Recognize unusual needs of some campuses

Important to include this once again in future years when we are out of the woods

Real Problem

The citizens of this state expect...and deserve...state services which exceed the present revenues...

Indeed, there are strong signs that we simply are underinvesting in

the future of this state...

Hence, the real question that we will eventually have to come to grips with is not the expenditure side of the equation...but rather the revenue side...

The future of our state depends on this...