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Boosting Michigan's Economy Through Educational Improvements

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Testimony of

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My testimony today focuses on how Michigan can use educational investments to generate economic development benefits. A better economic future for Michigan requires a strategy that is proactive. Such a strategy requires selective investments, of sufficient size and sufficient effectiveness to cause significant improvements in Michigan's economic development.

As I have outlined elsewhere (Bartik 2009a), the goal of state economic development policy is to increase state residents' per capita income. An increase in per capita income is my definition of "economic development benefits." Per capita income can be increased by increases in employment to population ratios or real wages (wages after adjusting for price levels).

Increased state per capita income can be achieved through a variety of strategies. One such strategy is an improvement in state residents' skills. Such skill increases can be caused by educational investments.

Before presenting estimates of the economic development benefits of educational improvements, I want to clear up some common misunderstandings. Some commentators do not believe that educational investments can boost a state's economy. This belief is based on two incorrect assumptions. The first assumption is that state residents who attain improved skills will simply move out of state. The second assumption is that increases in state residents' skills will fail to induce the creation in the state of more and better jobs.

Either of these incorrect assumptions leads to the conclusion that economic development policy should primarily focus on directly interacting with employers to encourage job growth. Such employer-focused policies might include business tax cuts, business tax incentives, reductions in business regulations, or customized public services to business.

As I have outlined elsewhere, I believe that some of these employer-focused policies should be part of Michigan's economic development strategy (Bartik 2009a). However, Michigan's economic development can also be significantly positively affected through educational investments.

The first assumption, that Michigan residents who achieve higher skills will simply leave the state, is incorrect. Americans are less mobile than is sometimes assumed. Of persons born in Michigan, the 2000 Census found that 74 percent still live in Michigan. My research indicates that about 65 percent of all Americans spend most of their working careers in their birth state. Even among college graduates, about 55 percent of all college graduates spend most of their working careers in their birth state. This percentage is lowered only slightly by depressed conditions in the local economy (Bartik 2009b).

The second assumption, that increased skills of state residents will not attract jobs, is also incorrect. The availability and skills of a state's labor supply is one of the most important determinants of business location and expansion decisions. Research shows that for a given improvement in a state's labor supply, businesses respond by increasing employment and earnings by at least two-thirds as much (Bartik 2001). Labor supply increases cause increases in state labor demand.

In other words, there is some displacement of other state workers. But this displacement is limited. The state residents whose skills increase experience a personal increase in earnings. Their personal increase in employment and earnings displaces some employment and earnings of other state residents. But the two-thirds response of employers referred to above means that this displacement is only one-third. For every $3 increase in earnings of state residents whose skills

increase, the earnings of other state residents are reduced by $1. Total state earnings increases by $2.

THE ECONOMIC DEVELOPMENT BENEFITS FOR MICHIGAN'S ECONOMY OF EDUCATIONAL IMPROVEMENTS, CALCULATED ON A PER STUDENT BASIS

For a forthcoming book of mine on early childhood programs and local economic development, I have estimated the economic development benefits of a variety of educational improvements. For this presentation, I calculate the effects of these educational improvements on state per capita income. These calculations adjust for outmigration of state residents. I only count increases in per capita income that occur in the state of Michigan. These calculations also adjust for the likely response of employers to a labor supply increase. I assume that only two-thirds of the state labor supply increase is translated into higher per capita income in the state.

For each educational improvement, I calculate the effects for one Michigan resident experiencing the specified educational improvements. These calculations can be extended to large scale programs by multiplying the per-person effects by the number of persons experiencing the improvement.

The calculations show the benefits of each educational improvement for increases in state per capita income. The benefit is the estimated increase in the "present value" of per capita income. The educational improvement will cause increases in per capita income for many years over the person's work life. The present value calculation reflects that income increases many years from now are not worth as much as income received today. For the present value

calculations, I use a 3 percent real discount rate (Bartik 2008). And, as stated above, I only count income generated and received in Michigan.

I also note that these calculations reflect averages. Presumably the actual future implications for income, due to a given educational improvement, vary quite a bit across persons. The numbers reported here are the average effects on the present value of per capita income in Michigan, for a typical person.

I consider the effects on the present value of Michigan per capita income of the following improvements in education, for one Michigan resident:

- High-quality preschool for the disadvantaged
- High-quality universal preschool
- An increase in elementary test scores for one person
- High quality summer school in elementary school
- Experiencing a top quartile teacher for one grade in elementary school
- An increase in secondary test scores
- High school graduation
- High school career academy completion
- Community college graduation
- College graduation

Table 1 summarizes these estimated effects. I will now briefly discuss each of these results in turn.

High-Quality Pre-K Education for the Disadvantaged

Rigorous research shows that high-quality pre-K education significantly increases the later adult earnings of disadvantaged children. (For a review of the research, see Bartik 2008). These benefits occur even for a half-day program of one school year in length for four-year-olds.

How does such a limited program have such profound long-run effects? As Nobel-prize-winning economist James Heckman has said, “Skill begets skill and learning begets more learning. Early advantages cumulate; so do early disadvantages” (Cited at website of Pre-K Now). The self-reinforcing effects of skills development occurs for both so-called “hard,” cognitive skills (e.g., increases in reading or math test scores), as well as for so-called “soft,” behavioral skills (e.g., getting along with peers and the teacher, becoming able to postpone gratification). Disadvantaged children who participate in high-quality pre-K education show significant increases in reading and math skills be the end of pre-K. More importantly, these disadvantaged children, by the end of pre-K, are significantly more able to interact successfully in the school environment with fellow students and the teacher. These initial advantages in hard and soft skills lead children to be more successful in early elementary school. These successes cause the children to be viewed more favorably by teachers, fellow students, their parents, and the children themselves. Success in early elementary school in turn builds on itself and leads to later success in school. Participants in high-quality pre-K are likely to be assigned to special education or be retained in grade. Later on, participants in high-quality pre-K are more likely to graduate from high school, and go on to post-secondary education. But the effects on adult earnings go beyond what would be predicted simply due to increases in educational attainment.

Pre-K participants have less involvement in crime. Their employment rates and real wage rates go up by more than would be predicted simply due to increased educational attainment.

Based on research, the increased present value of real earnings in a state, due to one disadvantaged child participating in high-quality pre-K is $59,625. (See Table 1.) As high-quality pre-K can cost less than $5,000 for a half-day school year program, economic development benefits far exceed costs (IWPR 2008). The available research suggests that additional benefits, in excess of costs, could be obtained from expanding pre-K from one year to two years.

High-Quality Universal Pre-K Education

The effects per capita of universal pre-K are commonly thought to be lower for two reasons. First, it is believed that middle-income and upper-income children benefit less from pre-K than is true for lower-income children. Second, to some extent, universally accessible and free pre-K education will replace some private pre-K education that is already taking place. Some of this private pre-K education is of low quality, but other private pre-K education is of high quality. Therefore, the effects of universal pre-K should be downweighted due to this partial displacement of some current high-quality pre-K participation.

It should be noted that research provides but limited support for the assumption that benefits from pre-K education are dramatically lower for middle-income children than for lower-income children. For example, studies of Oklahoma's pre-K program suggest educational effects of pre-K are about as great for middle class children as for lower-class children (Gormley et al. 2005).

In my research, I have assumed that benefits of universally accessible pre-K per child area only 23 percent of the benefits of pre-K vs. no pre-K for a disadvantaged child (Bartik 2008). This is a very conservative assumption, as it assumes significantly lower benefits of pre-K for middle income children.

Based on this assumption, the benefits of universally accessible pre-K education, in increased present value of state earnings, for the average child participating in universal pre-K, are $13,714. This benefit significantly exceeds the costs per child of universal pre-K, which have been estimated to be less than $5,000.

Increase in early elementary school test scores

Higher test scores in reading and math in early elementary school are significant predictors of adult success. Presumably this predictive success occurs for similar reasons to the positive effects of high-quality pre-K. Children who perform better on reading and math tests in early elementary school will be viewed more favorably by teachers, their parents, and by themselves. Their initial success will lead to more positive future interactions with school, and greater self-confidence in their ability to succeed in school. As a result, they will be more successful later on in school, and will have higher educational attainment. This higher educational attainment, along with perhaps greater self-confidence, will contribute to higher adult employment rates and wage rates.

For this calculation, I consider an increase in both reading and math test scores that is equivalent to what the average child learns in one half of a school year.[1] This is a significant test

score improvement. However, it is an improvement that one can imagine being brought about by educational reform programs.

Based on the available research, such a test score improvement for one child would be expected to increase the present value of future earnings in the state by $41,560 (Bartik 2010). This suggests that it would be worth investing in even very expensive educational reform programs if they can significantly improve elementary school test scores.

High-Quality Summer School during Elementary School for Students Who Are Behind

Research suggests that targeted mandatory summer school in early elementary can significantly increase student learning. Research on mandatory summer school is largely based on Chicago's attempt to require that students below a certain achievement level go to summer school, and improve achievement to a certain level, or be retained in grade for the next year. Such a program provides strong incentives for students, parents, and teachers to improve academic performance during the summer session, to avoid student retention in grade. The program also provides incentives for students who are at risk of being required to go to summer school to reach higher achievement levels during the school year.

The Chicago research suggests that in such a program leads to students learning about two or three times more per week than these students typically learn during the school year. Even a summer session of only six weeks can increase achievement levels by three months (Roderick, Jacob, and Bryk 2004). (In addition, meta-analysis of the effects of summer school suggest it can raise academic performance by an "effect size" of 0.2 or 0.3, which in early

elementary grades can amount to two or three months of extra achievement in "grade level equivalents" (Cooper et al. 2000).)

Therefore, it seems reasonable to assume that high-quality summer school for students who are behind in elementary school can improve student test scores in reading and math by the equivalent of what students learn in two months of school. It is then possible to directly apply the results used above for how early elementary test scores affect adult earnings. A high quality summer school that boosted one student's achievement by two months would be predicted to increase the present value of adult earnings in the state by $16,624.[2]

It seems likely that a high-quality summer school program can be run for less than $2,000 per student.[3] Therefore, the economic development benefits of high-quality summer school in elementary school for students who are behind far exceed program costs ($16,624 is over 8 times the per student cost of $2,000).

Experiencing a Top Quartile Teacher for One Grade in Elementary School

Research also suggests there are enormous variations among teachers in effectiveness. For example, research by Gordon, Kane, and Stagier (2006) classified teachers into four "quartiles" of test score gains during their first two years teaching. They then examined how much students learned during the teachers' third year teaching, and how it varied with the teachers' prior performance. They found that students in the third year who had a "top quartile" teacher, compared to those who had a "bottom quartile" teacher, experienced test score gains equivalent to learning about 4.7 months more during the school year.

Based on the estimates above for the effects on the present value of state earnings of elementary test scores, we can estimate the benefits from having a top quartile teacher for one grade in elementary school for one student, compared to having a bottom quartile teacher. The present value of the gain in state earnings is $39,185. ($39,185 = (4.7 months / 5 months) × $41,560). Furthermore, obviously a given teacher will have many students. Therefore, it is worth spending significant resources to improve average teacher effectiveness in elementary school by even a modest amount.

Increase in Secondary School Test Scores

Research also suggests that an increase in test scores in high school will increase adult earnings. Higher secondary test scores will be associated with a greater probability of high school graduation, and a greater probability of college attendance and graduation. This higher educational attainment will tend to increase adult employment rates and wage rates. In addition, there is some evidence that higher test scores tend to increase adult earnings holding educational attainment constant.

I consider an increase in secondary test scores equivalent to what the average student learns in one-half year of high school.[4] (Research suggests that a one-half year test score improvement for one student will increase the present value of earnings in the state by $7,050.) This level of benefits is obviously sufficient to justify quite expensive programs to boost high school test scores.

It is noteworthy that improving test scores by one half year in elementary school has much larger effects than improving test scores by one half year in secondary school. The effects

of the same “grade level equivalent” improvement is over 5 times as great in elementary school as in secondary school. This pattern may reflect the greater potential for early intervention to have a broad range of self-reinforcing cumulative effects. Boosting test scores in early elementary test scores can more easily change the life course of a child. Changing the life course of secondary students is feasible, but more difficult.

High School Graduation

I also consider the state economic development benefits of converting a high school dropout to a high school graduate. To calculate these economic development benefits, I use data on the earnings of high school dropouts versus those who get a high school degree. I assume that the marginal student who we convert from a dropout to a high school graduate is less likely than the average high school graduate to complete post-secondary education. Based on estimates by Belfield and Levin (2007), I assume that this additional high school graduate will have the following post-secondary experience: four-fifths will have no further education; 14 percent will attend college but will not get a bachelor’s degree; 6 percent will get a bachelor’s degree.

Based on these procedures, along with data on how many high school graduates will stay in a state and the effects of high school graduates on state job growth, I estimate that converting one high school dropout to a high school graduate will have economic development benefits for a state’s economy with a present value of $175,234.

Based on these calculations, even relatively expensive programs to reduce high school dropout rates will be worthwhile. Dropout prevention programs will usually only reduce the dropout propensities of some modest proportion of those involved in the program. Some

participants in these programs would have graduated from high school without the program. And even in the most successful program, some program participants will still dropout of high school. But even if a program only converts a dropout to a graduate for 1 in 10 participants in the program, it would be worth spending a great deal of money per student for the program. For such a program, with a 1 in 10 success rate, it would be worth spending over $17,000 per student on the program ($17,523.40 = (1/10) × $175,234).

High School Career Academy Program

Much of the increase in job skills demand in the U.S. economy requires less than a four-year college degree. For many students, a good option for developing higher skills is a program that will develop career-relevant skills during high school. One program that has been proven by rigorous research to do so is the high school career academy program.

Career Academies typically serve between 150 and 200 students from grades 9 or 10 through 12th grade. Career Academies have three key features:

1) Each academy is designed as a small learning community in which teachers and students get to know each well, and teachers work as a team to help students.
2) Career Academies have a curriculum that combines and career material around a career theme.
3) Career Academies establish partnerships with local employers to help make sure the curriculum is relevant, to increase career awareness among students, and to provide work-based learning opportunities.

The Career Academy model has been studied with an experimental methodology by MDRC (Kemple and Wilner 2008). This experiment suggests that Career Academies have high earnings benefits relative to costs. The MDRC evaluation results show no effect, positive or negative, of Career Academies on postsecondary educational attainment. However, the Academies increased employment and earnings among students participating, compared to the randomly assigned control group, in follow-ups up to eight years after the scheduled high school graduation of the student.

Based on this MDRC study, the average effect of one more student participating in career academies on the present value of state earnings is an increase of $24,134. This calculation compares a student participating in career academies to a similar student who applied for admission to a career academy, but was randomly chosen to be in the control group. Because the entire high school career academy program only costs an additional $2,200 per student, the program clearly has economic development benefits for a state economy that far exceed costs.

Community College Graduation

Of the jobs requiring less than a four year college degree, many require skills that can be obtained at a community college. According to one study, about four-fifths of new jobs over the next decade will require more than a high school degree. But of the new jobs requiring more than a high school degree, a majority will not require a four-year college degree, but rather some lesser post-secondary credential such as an associate's degree or a completion of some community college certificate program (Holzer and Lerman 2007).

To analyze the economic development benefits of a community college degree, I compared the earnings of those persons with an associate degree, but not a bachelor's degree, to high school graduates without any post-secondary degree. Based on this analysis, getting one person to have an associate degree provides state economic development benefits whose present value is $126,995. Obviously the tuition and other economic costs of obtaining an associate degree will usually be far less than $126,995.

College Graduation

I also considered the state economic development benefits associated with one more student obtaining a four-year college degree. This analysis is based on comparing earnings of persons with a bachelor's or higher degree, to the earnings of persons with a high school degree but without a bachelor's degree. Based on this analysis, I estimate that the state economic development benefits from one additional bachelor's degree have a present value of $375,912. This figure in general far exceeds the likely tuition and other economic costs of obtaining a four-year degree.

THE ECONOMIC DEVELOPMENT BENEFITS FOR MICHIGAN'S ECONOMY OF LARGE-SCALE PROGRAMS OF EDUCATIONAL IMPROVEMENT

The ten educational improvements discussed above all show large benefits for a state economy from educational improvements for even one person. These benefits are often large relative to the likely costs of obtaining these improvements. Therefore, the Michigan economy is likely to benefit from large scale programs that would obtain such educational improvements.

What policy strategy would be most likely to move us towards educational reforms that would obtain such educational improvements in Michigan on a large scale? I suggest a two-pronged strategy. First, the state needs to increase the total amount it invests in education. Second, the state needs to focus such investment on the educational programs with the highest returns in achieving educational improvements. (See Table 2 for a summary of the following large-scale initiatives.)

On the first prong, one rational way of increasing total educational investment is for the state to fund an "adequacy" study of K-12 education in Michigan. Such a study would combine research evidence, professional opinion, and public input to determine what funding per student is needed to achieve an adequate education for Michigan students. This would include some attempt to address the issue of what class sizes, teacher salaries, and overhead expenses are reasonably needed to achieve an adequate education for Michigan students.

I suspect such a study might find that adequate K-12 education in Michigan would cost significantly more per student than what we spend now, perhaps several thousand dollars per student more. However, what an adequate education really costs in Michigan is unknown, which is why such a research study makes sense. Such a study might also focus attention on some of the key program components, such as class size and how funds are allocated to various purposes (such as teacher salaries), and how these program components affect adequacy.

Once the cost of an adequate K-12 education in Michigan is determined, the state government can then develop a strategy for funding the needed spending per student. Although this lies outside the scope of this testimony, I think it is generally known among Michigan policy analysts what budget options must be explored if the state is to be able to fund significant

investments in K-12 education (or indeed any investments to promote state economic development). These budget options include broadening the sales tax to more services, increasing the progressivity of the income tax, limiting the preferential income tax treatment of senior citizens' income, correctional system reforms, and reforms to health benefits for public employees.

Increases in K-12 educational spending in Michigan should be focused on program initiatives with the best research evidence for high effects on student skills and hence the state economy. Five program initiatives that have such evidence include:

- Universal pre-K
- High-quality summer school in early elementary school
- High-school career academies.
- Bonuses for teachers receiving national board certification
- A more rigorous tenure process for new teachers

The first three have already been discussed above, and all I add are estimates of the costs and benefits of a large scale program. The latter two initiatives are derived from the above discussion of how improved teacher effectiveness benefits the state economy.

Universal Pre-K Education in Michigan

Getting to universally accessible pre-K for all four-year-olds is assumed to require state funding for 70 percent of all four-year-olds. The remaining four-year-olds would be in Head Start or private preschool programs, or would have families who choose not to participate in preschool programs. Oklahoma, which has been the leading state in implementing high-quality

pre-K programs, has 71 percent of all four-year-olds in state-funded pre-K programs, and over 90 percent of all four-year-olds in some type of pre-school program (NIEER 2008).

Michigan currently has 18 percent of the state's four-year-olds enrolled in state-funded pre-K, at a cost of about $104 million (NIEER 2008, and House Fiscal Agency Analysis of Conference Report on HB4447). (This is prior to the most recent budget cuts; the final impact of these budget cuts on enrollment in state-funded pre-K is unclear at present.) Expanding four year participation in state-funded pre-K in Michigan to 70 percent would cost an additional $300 million. This investment of $300 million would increase the present value of state residents' earnings by $834 million. This calculation is based on the numbers given above for the increase in earnings due to one more average student being enrolled in a universal pre-K program.

High-Quality Summer School Programs for Elementary School Students, for the Equivalent of 20 Percent of Students in One Michigan Elementary Grade

Twenty percent of a single elementary grade in public education in Michigan is about 24,400 students. (Of course, alternatively the program could fund summer school for the bottom 10 percent in two elementary grades.) Suppose such a program cost $2,000 per student, which, as discussed above, seems more than ample. Then the total cost of such a program would be $49 million per year.

Based on how such a program would be predicted to affect test scores, and the effects of test scores on later earnings, such a program would be predicted to increase the present value of state residents' earnings by 8.31 times its costs (8.31 = $16,624 / $2,000). A one-year program of $49 million would increase the present value of state residents' earnings by $406 million.

High-School Career Academies for 20 Percent of All Michigan High School Students

As mentioned above, career academies cost about $2,200 per student, for the entire high school program for one student. If Michigan enrolled 20 percent of its public school 9th graders in such academies, the program would cost in the long-run about $69 million per year.[5] Michigan would have to set up about 155 such academies that would initially enroll about 31,000 students. This enrollment would increase to three or four times that number as the academies filled out to include all four high school grades.

Based on the above calculations of earnings effects per student, this $69 million investment in Career Academies for just one cohort of Michigan 9th graders would be expected to increase the present value of Michigan residents' earnings by $757 million.

Bonuses for National Board Certification for Michigan Teachers

The National Board for Professional Teaching Standards runs a program that certifies teachers as having effective teaching skills. Research by Goldhaber and Anthony (2007) suggests that this certificate does succeed in identifying more effective teachers. National Board certified teachers, compared to similar non-certified teachers, on average cause students to learn the equivalent of about one-half month more during the school year.[6]

Suppose that Michigan set up a bonus program that provided National Board certified teachers with an annual salary bonus of $5,000. If 10 of Michigan K-12 teachers received such a certification and bonus, the annual cost would be about $37 million. ($37 million = 74,000 K-12 teachers times 10 percent times $5,000)[7].

The benefits of such a program depends upon what proportion of those receiving bonuses are induced to remain in Michigan teaching due to the bonus. Suppose that the bonus had a 10 percent effectiveness rate. That is, out of every 10 teachers receiving bonuses, one is induced to remain a Michigan teacher because of the bonus.

In that case, the bonus program would induce an additional 740 National Board certified teachers to teach in Michigan public schools. On average, each of these teachers will have 23 students. The present value of the Michigan earnings increase from these additional teachers, for one year of teaching (so that the numbers are comparable to the one-year cost figure) would be $71 million.[8].

Of course, as this program would continue over time, the eventual benefits for Michigan's economy would be far greater, as would the costs. Each year would increase benefits and costs by $71 million and $37 million, respectively.

More Rigorous Teacher Tenure Standards

Gordon, Kane, and Stagier (2006) have done simulations of the long-run implications of imposing more rigorous teacher tenure standards. Suppose school districts regularly denied tenure to the lowest quartile of new teachers. Over time, this would increase the average effectiveness of the teaching staff. Given the large annual turnover in teaching staff, and the impending retirement of many teachers, this measure would affect a large proportion of all teachers within 5 or 10 years. On the other hand, denying tenure to more teachers would also increase the average proportion of teachers who are first year teachers, who tend to be less effective. Gordon, Kane and Stagier show that the net long-run effect of this program would be

to raise the overall effectiveness of the teaching staff so that students learn about 0.56 months more in learning during a typical school year.

In the long-run, such a measure would raise the overall productivity of the Michigan workforce. Some calculations suggest that the net effect would be to raise the annual earnings of Michigan workers, by itself, by about 2.4 percent. This is equivalent in today's economy to an increase of $4.5 billion per year.[9]

Of course, this assumes a tenure regime that perfectly screens out the bottom quartile of teachers before they attain tenure. In the real world, such perfection seems unlikely. But the gains from even an imperfect system of more rigorous tenure standards seem large. Even if a more rigorous tenure system is only one-fourth as effective as this assumed "perfect" system, the potential economic gains to the Michigan economy are over $1 billion per year.

CONCLUSION

In sum, there are large benefits for the Michigan economy from making improvements in our educational system. These large benefits are apparent when calculating benefits on a per student basis, as well as when calculating the benefits from large scale educational improvements.

These large economic development benefits occur due to increased skills for Michigan residents. A sizable percentage of Michigan students who benefit from educational improvements will stay in their state. The resulting increased skills of Michigan residents will attract more and better jobs to the state.

The most important barrier to making these educational improvements is political. There is good research evidence that such improvements can be made, and can have the desired economic benefits. The barrier is that making such educational improvements frequently has large up front budgetary costs. The political issue is that making room for educational investments requires some difficult budgetary decisions. These difficult budgetary decisions include significant tax and spending system reforms.

NOTES:

1. For those readers familiar with educational test score jargon, this improvement is an "effect size" of 0.5.

2. The above calculation was for a test score improvement of five months or one-half school year, and showed a present value earnings impact of $41,560; $16,624 is the equivalent adult earnings effect for a smaller test score boost of two months ($16,624 = (2/5) × $41,560).

3. Conversations with budget staff at Kalamazoo Public Schools suggest a per student cost for summer school of about $1,000. However, this cost may not reflect all added administrative costs. It also would be advisable to put extra resources into monitoring and ensuring quality.

4. For those familiar with educational jargon, this improvement is equivalent to an "effect size" of 0.1.

5. This is the long-run cost after 20 percent of all four high school grades are in the academy, or the per cohort costs. The numbers of 9th graders are based on figures for 2005–2006 from the Center for Educational Performance and Information.

6. In education jargon, the "effect size" is to increase student performance by about 0.05 standard deviations.

7. The figure for the number of K-12 teachers is derived from using figures on K-12 enrollment, and the statement from the Center for Education Performance and Information that the ratio of K-12 students to K-12 teachers is 23 to 1.

8. $71 million = 740 × $41,560 (from section on test score effects) × (0.5/5) [to adjust for lower test score effects of NB certification compared to what was considered in section on test score effects] × 23 students.

9. The calculation goes as follows. Boosting teacher effectiveness by an "effect size" of 0.056 eventually boosts student performance over 13 years by 13 times 0.056 = 0.728 effect size. The calculations in a previous section show that an effect size increase in secondary school of 0.1 has an effect on the present value of earnings of $7,050. Therefore, the increase in the present value of earnings of one student due to this increased student effectiveness will be 7.28 times as much, or $51,324. Total Michigan employment in 2008, from the Regional Economic Information Service of the U.S. is 4.263 million. I assume that 69 percent of those workers in the long-run will be workers who went through the public K-12 education system in Michigan. (This is based on figures that 75 percent of Michigan's population was born in Michigan, and that K-12 enrollment in public schools is 92 percent of total K-12 enrollment.) Therefore, the total present value of Michigan earnings will increase by $151.6 billion (= $51,324 × 4.263 million × 69 percent). With a 3 percent discount rate, the annual equivalent of that present value boost is $4.5 billion (= 3 percent × $151.6 billion). According to the REIS, total Michigan wage and salary earnings in 2008 was $186.2 billion. Therefore, this boost in earnings is 2.4 percent of total Michigan wage and salary earnings.

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Table 1 Economic Development Benefits for Michigan of Educational Improvements

For one Michigan resident attaining the below educational improvement:	The resulting increase in the present value of earnings in Michigan will be:
High-quality pre-K for disadvantaged	$ 59,625
High-quality universal pre-K	$ 13,714
Increase in early elementary school test scores equivalent to one-half school year	$ 41,560
High-quality summer school during elementary school for students who are behind	$ 16,624
Being taught by a top quartile teacher rather than a bottom quartile teacher for one grade of elementary school	$ 39,185
Increase in secondary school test scores equivalent to one-half school year	$ 7,050
High school graduation	$175,234
High school career academy	$ 24,134
Community college graduation	$126,995
4-year college graduation	$375,912

NOTE: The effects of these educational improvements are calculated for one Michigan resident experiencing that educational improvement. The earnings effects calculated are the present value of the increased earnings stream generated in Michigan due to one additional person experiencing that educational improvement. The earnings effects are adjusted downward to reflect Michigan residents who move out after experiencing the educational improvement. The earnings effects are also adjusted downwards to reflect some displacement of other Michigan workers due to this one person experiencing the educational improvement. The educational improvements are compared to the following counterfactuals, going through the table row by row: a disadvantaged child who does not go to any pre-K program; the "average" child, who may go to some pre-K program even if this universal pre-K program did not exist; a child whose test scores in early elementary school are behind by one-half grade level compared to this child; a child who is behind in elementary school who does not go to summer school; a child who has a bottom quartile teacher for one grade in elementary school; a child whose test scores in secondary school are behind by one-half grade level compared to this child; a high school dropout; a high school graduate who applied to a career academy and was turned down; a high school graduate who did not graduate from a community college or a 4-year college; a high school graduate who did not graduate from a 4-year college.

Table 2 Large Scale Educational Programs to Improve Michigan's Economic Development

Large-scale program	Costs	Economic Development Benefits
Adequacy study	$2,000 to $3,000 per K-12 student?	?
Universal pre-K for 4 year olds	$300 million	$834 million
High-quality summer school in early elementary	$ 49 million	$406 million
High school career academies	$ 69 million	$757 million
Bonus for National Board certification	$ 37 million	$ 71 million
More rigorous tenure process	?	$4.5 BILLION in LONG-RUN if PERFECTLY done

NOTE: See text for derivation of estimates.