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An Economic Analysis of Four-Year-Old Kindergarten in Wisconsin: Returns to the Education System

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Dear Colleague:

Parents have long recognized the strides their young children make when they attend a high-quality pre-kindergarten program. Now economists can actually quantify the benefits of pre-k, not just to children and families, but to schools and society. By comparing the dollars needed to fund pre-k with the dollars saved when children don't require expensive services later, economists can calculate the savings from pre-k investments. These savings manifest in reduced grade repetition, fewer special-education placements, lower crime rates, and reduced reliance on welfare.

Wisconsin has a long history of offering pre-k (officially called 4K) to all the state's four-year-old children. Since 1848, the Wisconsin State Constitution has required school districts to provide free public education to all children between four and twenty years of age. Additionally, Wisconsin is fortunate to have state leaders who understand the benefits of pre-k. Governor Jim Doyle, State School Superintendent Libby Burmaster, and a number of key legislators have vigorously promoted the importance of 4K for Wisconsin's children.

However, currently, only 50 percent of Wisconsin school districts offer 4K to children in their area. Among those districts not offering pre-k are several large, urban school systems, such as Madison. Because of this limited availability, only about 18 percent of children in Wisconsin currently participate in state-funded 4K. For much of Wisconsin, pre-k remains a missed opportunity.

In an effort to quantify the magnitude of this missed opportunity, Dennis Winters of NorthStar Economics and Dr. Clive Belfield have calculated the savings to the Wisconsin education system that would result from expansion of the 4K system. The results are persuasive; for every \$1 invested, 68 cents would be saved during the K-12 years. The savings to the Milwaukee district are even more impressive; for every \$1 invested in 4K, the school system would save 76 cents in the future.

Pre-K Now thanks the authors for this compelling economic analysis of pre-k expansion in Wisconsin and the Trust for Early Education for funding the original research.

Sincerely,

A handwritten signature in black ink that reads "Libby Doggett".

Libby Doggett, Ph.D.
Executive Director
Pre-K Now

An Economic Analysis of Four-Year-Old Kindergarten in Wisconsin: Returns to the Education System

Departments of Education nationwide are finding that investments in pre-kindergarten programs yield significant later savings across the budgetary board, from reductions in special education expenditures to improved teacher-retention rates.

This study shows that in Wisconsin, for every state dollar invested in pre-k, 68 cents would be returned in savings to the education system. In Milwaukee, the benefits are even greater at 76 cents saved for every \$1 invested. Wisconsin already has a proud tradition of investing in pre-k. It is clear from these figures that those are dollars well spent and that increased investment will produce even greater returns.

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Executive Summary

This paper considers the economic impact to the K-12 education system in the state of Wisconsin and in the district of Milwaukee from expanding provision of pre-kindergarten, which is known in Wisconsin as four-year-old kindergarten (4K). The proposed investment would make 4K available to a significantly larger number of children in the state.

Prior studies have found significant benefits from pre-k programs. These are briefly reviewed [Section One].

For Wisconsin, expanding the 4K program by a factor of three would allow 32,102 extra four-year-old children to participate each year (in other states, around 70 percent of families take advantage of high-quality pre-k). For these new places for children, the total investment cost would be \$207 million. This is less than 3 percent of annual expenditures on education in Wisconsin [Section Two].

The proposed program would generate strong benefits for the state (e.g., reduced crime and reliance on welfare) as well as benefits to the children and their families. The focus here is on the consequences of expanding 4K for K-12 educational budgets in Wisconsin. The education system is affected because children progress more efficiently through their schooling as a result of early-childhood programs. State-specific data, published research, and new evidence are used to estimate these fiscal benefits to the school system [Section Three].

With expanded 4K programs fiscal benefits to the K-12 school system would come from:

- lower grade retention;
- lower special-education placement;
- higher job satisfaction for teachers;
- more teachers retained by the public schools;
- fewer substitute teachers;
- reduced spending on school safety; and
- reduced pressure on student-aid services.

In total, these benefits amount to \$140.96 million.

The net economic impact of comprehensive statewide pre-k is calculated as a benefit-cost ratio [Section Four]. For each cohort of four year olds, the benefits of investment in comprehensive 4K offset 68 percent of the costs. For every dollar committed to 4K, 68 cents would be returned in savings.

The analysis is also performed for the Milwaukee school district. This district has higher, K-12, per-student expenditures, and higher rates of grade repetition and special education. Accordingly, the K-12 cost savings are found to be higher. The benefits of investment in comprehensive 4K for Milwaukee would offset 76 percent of the costs of the program, when only K-12 educational budgets are considered.

These results are robust to alternative assumptions. When all benefits are accounted for, there is a clear economic motive for investment in four-year-old kindergarten across the state of Wisconsin.

Section 1: Introduction

1.1 Investing in Young Children

Education programs for young children are an investment in the future: they create opportunities for the children involved and generate economic benefits for society at large. The social benefits, mediated through government provision of services, may be substantial, and perhaps sufficient to offset the costs of the investment. The purpose of this report is to calculate the fiscal benefits for one domain, the K-12 education system, from expanding four-year-old kindergarten (4K) in Wisconsin.

The appropriate framework for analysis of the costs and benefits of expanding 4K is a balance sheet. On one side of the balance sheet are the costs of the program. The costs include staff salaries, classroom space, and curriculum materials.ⁱ For high-quality programs, investments must be made in: curriculum plans; teachers with certification and in-service training; meals; and screening and referral services (see NIEER, 2003).

Offsetting these program costs are the benefits across early-childhood-education programs. Prior studies, focused on high-quality programs, have identified a considerable number of benefits for the individual child. Individual benefits include:

- enhanced academic attainment;
- improved health;
- higher probability of graduating from high school and/or going to college;
- higher wages; and
- lower probability of involvement in criminal activities.ⁱⁱ

Similarly strong benefits from pre-k programs are generated for society. Societal benefits include:

- higher tax payments by participants;
- lower reliance on welfare; and
- lower rates of criminal activity.

Prior studies have established that these benefits alone are sufficient to pay for the costs of providing early education.

The focus here is on the gains to the Wisconsin K-12 education system. These gains arise because children, as a result of 4K, are now better prepared for school and they can learn more effectively. Specifically, studies have found that pre-k programs:

- reduce the incidence of special education;
- lower the rate of grade repetition; and
- raise learning productivity within the school.

The general effect is a more efficient education system with less pressure on school resources and expenditures.

Using this balance sheet framework, this report provides empirical estimates of the costs and benefits of expanding 4K across the state of Wisconsin and for the district of Milwaukee.ⁱⁱⁱ The perspective adopted is that of the school system; it is school-district officials and boards that must decide whether to commit resources to pre-k, and these groups need to identify whether this investment is worth making from their own perspective.

The outline of the report is as follows. In Section Two, the policy scenario: to significantly expand pre-k through the 4K program in Wisconsin, is set out. The impact on 4K enrollments is described, and the total cost of such a policy is estimated. Section Three describes in detail the full economic benefits to the K-12 education system, which may be anticipated from this policy change. Both prior evidence and new empirical research results are used to estimate these economic benefits; data from Wisconsin Department of Public Instruction are also applied. In Section Four, the resultant cost savings are set against initial investment costs. This allows for adjudication as to whether a comprehensive program yields economic benefits. Sensitivity analysis is performed to see how the amounts of cost savings might vary. Finally, Section Five gives a concluding summary.

A complete Technical Appendix, enumerating the calculations supporting these findings is available from the authors.

The best estimates indicate that investment in 4K for all will yield cost savings to education budgets of 68 percent (statewide) or 76 percent (Milwaukee) of the initial investment.

Section 2: Four-Year-Old Kindergarten in Wisconsin

This section sets out a scenario for changes to pre-k programs. The proposed change is the implementation of a comprehensive pre-k program offering 4K to all children aged four in the year prior to their entry into kindergarten. This proposed policy would therefore significantly expand the opportunities for early education in Wisconsin.

A full economic evaluation has four components. First, the consequences for enrollments in 4K in Wisconsin need to be considered in light of the existing patterns of options. Second, the unit and total costs of new 4K programs to accommodate changes in enrollment patterns must be calculated. These two steps are performed below. The next two steps are: to estimate the economic benefits of 4K and to link these benefits to the costs. These are performed in Sections Three and Four.

2.1 Pre-K Enrollments

Demographic Information

In Wisconsin, there are 89,170 children aged four years (Census, 2000). To simplify the analysis, a one-time investment in this cohort of four year olds in 2004 is assumed. (The analysis may then be applied to the next set of four year olds (in 2005), and to subsequent age-cohorts).

The proposed policy assumes that all 4K programs would be high quality, such as a rating of five or above on the Early Childhood Environment Rating Scale – Revised, (ECERS–R, see Harms et al., 1998).^{iv} (This threshold rating corresponds to a program such as the High/Scope Perry Pre-School program). Fundamentally, such high-quality pre-k is established through the allocation of sufficient resources.

Offering access to four-year-old kindergarten for all children would alter the composition of children spread across the current pre-k programs in Wisconsin. Children fall into a number of categories in terms of provision. Some families will not enroll in 4K, even when it is high quality and offered at no cost. This group has no impact on the fiscal analysis. A second group receives pre-k through federal programs (Head Start or Title 1 Pre-K) or through special education. This group would also be unaffected in this policy simulation. A third group currently receives programs of sufficient quality; it too has no impact on the analysis. Finally, the last group consists of children who do not currently participate in pre-k but would participate if it were of high quality, accessible, and delivered free. This group would now have the option to attend a pre-k program.

Table 2.1
Provision of Pre-K for One Cohort of Four Year Olds

Provision Types in Wisconsin	Current Provision*	4K for All
Public Early Childhood Special Education	6,240 (7%)	6,240 (7%)
Federal Head Start	8,026 (9%)	8,026 (9%)
Wisconsin Head Start	890 (1%)	890 (1%)
4K	16,051 (18%)	48,153 (54%)
No public provision	57,963 (65%)	25,861 (29%)
Children aged four	89,170	89,170

*Note: *Head Start programs are also available for three year olds. This table does not include demographic information on childcare provision across the state. Sources: Census (2000); Wisconsin Department of Public Instruction; NIEER Yearbook (2003).*

The distribution of provision and children is given in Table 2.1. The first column shows the current distribution of children. The second column shows the distribution of children under the proposed policy (labeled ‘4K for All’).

Currently in Wisconsin, federal programs and special-education provision account for 17 percent of all children. The current 4K program enrolls 16,051 children, 18 percent of all children. This demographic pattern leaves 65 percent of the age cohort without state-supported pre-k provision. (These families may rely on some other form of pre-k, but its quality is unlikely to generate the types of outcomes anticipated from high-quality programs).

Under an expanded pre-k program, ‘4K for All’, high-quality provision would grow by a factor of three. (The program would be voluntary, but given the benefits of 4K, it is expected that many families would participate given the chance). The demographic impact for the cohort is shown in the right-hand panel of Table 2.1. Children in the federal programs and in special education remain as designated, but the numbers in 4K would grow by 32,102, to 48,153 children being served. This is a substantial commitment to comprehensive 4K for all four year olds. Nevertheless, such a policy would have an enrollment rate below states where pre-k is comprehensive (Georgia and Oklahoma). Because pre-k is voluntary some families choose not to enroll their children. Therefore we use an enrollment rate of about 70 percent.

The same policy is assumed when looking just at Milwaukee. The total cohort student numbers are lower (7,925 four year olds), but equivalent distributions of children are assumed, as per Table 2.1.

The intention is to imagine an ambitious yet feasible policy which offers all families an opportunity for 4K, but does not make pre-k programs compulsory. Importantly, these pre-k programs must be high quality to ensure that the benefits to the children and the state are realized.^v

State Programs and Funding^{vi}

Historically, the Wisconsin State Constitution has supported programs for younger children. But in the 1920s, schools shifted toward provision from age five, with kindergarten becoming a half-day program for five year olds. Funding commitments for younger children also declined over the period 1957-1984, although Head Start, Title I, and special-education programs offset this decline. In the 1980s, the state legislature re-introduced financial aid for four year olds and increased funds for full-day kindergarten for five year olds. This encouraged more districts to introduce four-year-old kindergarten programs; by 2001, they were offered in over one-third of districts. Since 2001, the state has debated whether to increase funding for full day programs for four year olds or to eliminate funding entirely.^{vii}

Wisconsin’s 4K program is available to all four year olds in the districts where it is offered, and not just targeted to only high-needs or low-income children. In most cases, financing is shared between the state and local school districts: on average 63 to 64 percent of the funding for 4K is provided by the state, but the level of commitment provided to individual districts varies significantly above and below this average. Funding is based on student enrollment, with 4K pupils counted as 0.5 full-time equivalent students for state funding. This is based on 4K programs of two and one-half hours per day (although additional funding is available for parental outreach activities). Local school districts that offer full-time 4K must fund the additional expenditures directly.^{viii}

Section 2: Four-Year-Old Kindergarten in Wisconsin

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However, programs are locally controlled: school boards determine if they will provide programs and specify class sizes or teacher-child ratios. Provision is focused on high-quality programs: teachers must have a BA degree and an early-education license from the Department of Public Instruction; the curriculum includes reading and language, arts, math, social studies, and science; children must have access to transportation and special-education services; and outreach programs are encouraged.^{ix} State programs follow a community-based approach, allowing parents to access 4K through a range of providers, including schools, community sites, private childcare providers, Head Start, and private homes. This approach also involves many stakeholders and encourages the development of innovative programs suited to local needs.^x

Because Wisconsin has a diverse range of pre-k providers, both as part of the 4K system and operated privately, it is very difficult to establish their unit costs and their impact on children's development.^{xi} Their quality, in terms measured by, for example, ECERS-R, is unknown, so it cannot be established to what extent the expanded program would supplement or supplant existing, privately operated pre-k. Wisconsin's efforts to expand 4K do include a major emphasis on approaches where 4K services are delivered in community settings like childcare and Head Start. This economic study does not address these issues, but merely assumes that any expansion of 4K would build on and complement existing public and private, early-education and care programs, delivered by the various service providers in local communities.

It is important to be clear about the purpose and relevance of this model. The model uses only one year of data (2002); this is to ensure that the costs and benefits can be compared consistently. However, the 4K system in Wisconsin is evolving. Across the 416 districts with elementary schooling, over the academic years 2000-2004 there has been a 50 percent increase in the number offering 4K, with a 54 percent increase in the numbers of children enrolled in 4K. In the academic year 2000, enrollment was 12,100 across 138 districts; by 2004, enrollment is 18,652 across 208 districts. With changing enrollments and changing amounts of funding, it is more accurate to use a single year to calculate resource investments per child.

The intention is to calculate the consequences of a proposed policy to expand 4K to cover more children while maintaining the same level of provision for existing 4K enrollees. It is not a statement of the specific amount of funds that should be approved by the legislature. It is also not informative either about how to allocate any additional funds between districts or within districts or about the relative burden of financing between state and local jurisdictions. Other procedural matters are also beyond the scope of the model; these include lags in funding across districts, the calculation of funding based on three-year moving averages, and the relationship between 4K and Head Start. Instead, the model is intended to evaluate whether 4K enrollments should be expanded, without detailing how this expansion is to be managed.

2.2 Pre-K Expenditures and Unit Costs

Expenditures and unit costs data from Wisconsin Department of Public Instruction (WDPI) are used to calculate the financing necessary for 32,102 new 4K pupils.

The unit costs for 4K programs are reported in the first column of Table 2.2 (with notes and sources below the table). In 2003, actual unit cost per child participant was \$3,518. Compared to other states, this amount is low and may not be sufficient to guarantee high-quality programs in all settings. Costing exercises have found that high-quality programs require more resources, by a factor of 27 percent (Marshall et al., 2002). A second costing formula is therefore considered, where guaranteed high-quality programs would cost \$4,468 per child. Also, a third costing formula is reported. Based on the costs per child in Head Start in Wisconsin, 4K is estimated to cost \$6,445 per child. This last unit cost is the highest, but may be the most plausible: it is closer to the unit costs of a year of kindergarten in Wisconsin; and it allows for the marginal unit costs of the expanded provision to be higher than the current average unit cost as well as to ensure that each is high quality.

Based on these unit costs, column two of Table 2.2 shows the total investment costs for the proposed program. These total costs are calculated as the cost per child under each formula times the numbers of new 4K pupils (32,102). Under current cost structures, the present-value investment for this proposed expansion of 4K would be \$112.93 million. This is less than 1.3 percent of the total investment commitment that the state is making to these children over their entire schooling life. If formula II is used, the investment cost would be \$143.43 million. If formula III is applied, the cost would rise to \$206.90 million. Even under this assumption, the resource commitment is less than 3 percent of the total amount to be invested in these children over their school life.

Table 2.2
Proposed Additional Spending for
“4K for All” Programs

Costing Formulas	Unit Annual Cost Per Child	Total Extra Investment (\$ million)
[I] Actual	\$ 3,518	\$ 112.93
[II] Guaranteed high quality	\$ 4,468	\$ 143.43
[III] Comparable to Head Start	\$ 6,445	\$ 206.90

Notes: ‘Actual’ refers to current 2003 expenditures on 4K. ‘Guaranteed high quality’ requires 27 percent more resources than are needed for ‘Actual’. ‘Comparable to Head Start’ assumes that 4K providers will receive funds equivalent to Head Start funding.

Sources: NIEER Yearbook (2003); Marshall et al. (2004); and Head Start data.

The same formulas can be applied when looking at the Milwaukee district. Given the total cohort of students, the total costs of the proposed policy would be \$11.29 million, \$14.34 million, and \$20.69 million across formulas I-III, respectively.

The next section itemizes the benefits that should accrue to the education system from making such an investment in 4K.

Section 3: Fiscal Benefits to the Education System

This section calculates the magnitude of the economic benefits of early childhood programs within the context of state education in Wisconsin. To model the consequences of a comprehensive pre-k program, it is necessary to enumerate these impacts in full. (Again, it is important to emphasize that there are many other benefits from investments in children's education).

These benefits include cost savings, which arise from increased efficiency in the school system: reductions in special education and grade retention and improvements in learning productivity. This last impact is traced through student achievement and behavior. Put simply, more proficient students reduce unit costs of education.^{xii} Such cost savings are important to state departments of education, and they are detailed in this section.^{xiii} Throughout, all money values are expressed in present-value, 2004 dollars.

To calculate these benefits, it is necessary to model the relationships between pre-k, future schooling, and future educational expenditures. Therefore, this section begins by clarifying the assumptions behind this model.

3.1 Modeling the Impacts of Pre-K Programs

Targeted Programs Versus Programs for All

The economic model applied here uses evidence from the high quality studies noted in Section One. However, most of the high-quality evidence on the benefits of pre-k programs comes from targeted programs for at-risk students. For Wisconsin, existing pre-k programs are also provided mainly for low-income families. These are the children who are most likely to benefit, so it is legitimate to ask whether all children would benefit to the same extent under an expanded program. Typically, four arguments are considered to relate targeted programs and programs for all.

First, there is evidence that programs for all do have positive impacts. Studies of statewide programs in Oklahoma and in Georgia have found generalized benefits, at least in terms of academic achievement.^{xiv} This suggests widespread gains across many groups of children.

Second, even as studies have looked at targeted populations, these are representative of a reasonably high percentage of all children. For example, the Perry Pre-School Program target group was those children at risk of dropping out of high school. Nationally, at least 10 percent of 16 to 24 year olds are dropouts. Wisconsin DPI data shows a 92 percent graduation rate; however, using the federal Cumulative Proportion Index, less than 79 percent of all public school students in Wisconsin graduate on time (Swanson, 2004). (For Milwaukee, the DPI graduation rate is considerably lower, perhaps at 36 percent, BAE0). Also, the achievement gap is not a 'binary divide' between two groups: studies indicate that middle-income families are as far behind high-income families as they are ahead of low-income families. Many children would benefit from pre-k programs, although clearly some would benefit more than others.

Third, some of the benefits from pre-k may be magnified as increasing numbers of children participate. Only with a critical mass of more-able or better-prepared students will there be significant resource savings within schools, for example.^{xv}

Finally, targeted programs may not adequately reach the intended children. (They also raise the costs of screening children, of determining who is eligible, and of monitoring eligibility). If targeting is inaccurate, then there may be both efficiency and equity reasons for offering expanded provision to ensure all children who merit pre-k programs receive them.

Lasting Impacts from Pre-K Programs

Another concern is “fade out” from pre-k programs, such that achievement gains are only evident in the early years. Some studies have found academic fade out (see Currie and Thomas, 1995; Lee and Loeb, 1995). Others argue that early gains set children on a different trajectory, such that ‘skills beget skills’, eventually leading to labor-market success (Carneiro and Heckman, 2003). Equally important, studies have not found behavioral fade out; studies such as the High/Scope Perry Pre-School Program show behavioral differences that are accentuated over time.

Specifically, educational impacts have been found to be long-lasting in relation to progression through schooling, e.g. in terms of whether a student repeats a grade or is in special education. This discrepancy could reflect measurement error in achievement tests (or compression in the distribution of test scores). Or, there may be more rapid progression of high-achieving students through the education system. The most plausible explanation is that early-childhood programs generate strong and durable gains in ways not restricted to test scores.

Conservative Assumptions

To ensure that gains are not overstated, a conservative approach is adopted in creating the model. Thus, if there are strong economic returns from pre-k when cautiously estimated, then there should be reasonable confidence that these gains do exist.

This conservative approach has four components. First, all assumptions are drawn from published studies where possible. Second, whenever alternative assumptions or parameter values are plausible, the more conservative one is applied. (Identification of multiple values of parameters also helps in triangulating the results). Third, where benefits from pre-k are

anticipated, but there is inadequate data to enumerate them, they are omitted from the analysis (such as multiplier effects from investing in jobs for workers in the pre-k sector). Fourth, a standard discount rate is used, as advocated from a full and recent review of discounting by Moore et al. (2004).^{xvi} This discount rate for weighting all future benefits is 3.5 percent.

Together, these assumptions should yield estimates of the impact of the proposed policy, which are conservative. It is unlikely that this economic analysis will have overstated the educational advantages of the proposed investment.

Finally, and crucially, the benefits calculated in this report are only a fraction of the full set of benefits. Other studies have identified societal benefits in terms of lower crime, reduced reliance on welfare, and increased tax contributions. These are all benefits to the state either as lower expenditures or higher revenues. Moreover, there will be benefits to the participants in pre-k programs. These benefits are likely to be substantial, and they should be part of a full cost-benefit analysis in deciding whether to commit further resources to 4K.^{xvii}

Sensitivity Analysis

The economic model also includes a sensitivity analysis. This tests whether the results are robust to the assumptions of the model. For exposition, two different models are applied. The two models are labeled #1 ‘representative’ and #2 ‘conservative’. (Both models are cautious, for reasons given above). The economic impacts are unlikely to be below these amounts.

Section 3: Fiscal Benefits to the Education System

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3.2 Cost Savings from Special Education and Grade Retention

The main impact of pre-k for the school system is the reduction in the incidence of special education. This effect is well documented (Reynolds et al., 2000; Barnett, 1996).^{xviii} The second impact of pre-k is the reduction in grade retention; this effect is also well established, although it is not as economically significant as that for special education.^{xix} Both of these impacts can be calculated by adopting a full educational-accounting framework.

An educational-accounting framework itemizes the full set of expenditures for each child in Wisconsin during his or her time in the public school system. As each child enters kindergarten, the school system commits to 12 years of public schooling, funded by the state. Crucially, pre-k programs will influence the size of

that commitment. Using accounting data from Wisconsin Department of Public Instruction, along with impact effects, it is possible to estimate the difference in the commitments required under an expanded four-year-old kindergarten program.

In fiscal year 2003, average Wisconsin per-pupil spending on each year of regular education is \$9,919; and per-pupil spending on each year of special education is proportionately higher, at \$18,846 (CSEF, 2004). Depending on which track these children follow, they will receive present-value expenditures over the next 12 years of: \$94,733 if they do not repeat a grade or receive special educational services; \$101,775 if they do repeat a grade but do not receive special educational services; or \$181,513 if they receive special educational services. Total costs can be calculated based on the tracks these students follow.

Table 3.1
Cost Savings from Reductions in Special Education and Grade Retention

	Current Provision	Cohort Entering Kindergarten in 2005 with 4K for All	
		Model #1	Model #2
Students Per Category (%):			
Regular education (non-repeater)	83.3 %	84.1 %	82.23 %
Special education	14.4 %	13.8 %	14.0 %
Repeats one grade	2.3 %	2.1 %	2.2 %
Costs Per Category:			
Regular education (non-repeater)	\$ 94,733	\$ 94,733	\$ 94,733
Special education	\$ 181,513	\$ 181,513	\$ 181,513
Repeats one grade	\$ 101,775	\$ 101,775	\$ 101,775
PV K–12 Expenditures (\$ billion)	\$ 8,431	\$ 8,387	\$ 8,400
PV Cost Savings (\$ million):			
Reduction in special education		\$ 42.41	\$ 30.04
Reduction in grade repetition		\$ 0.95	\$ 0.42

Notes: Present-value (PV) figures are discounted over the child's educational span from K–12 at a discount rate of 3.5 percent. Economic values are in 2004 dollars.

Table 3.1 traces through the impacts and costs. Initial grade-repetition rates in Wisconsin are 2.3 percent of regular education students (WDPI, 2004). However, the state incidence of special education is relatively high: the public school proportion is 14.4 percent, compared to the national average of 13.2 percent (NCES, 2003, Table 55). With the current provision of pre-k, the remaining 83.3 percent of students follow the regular educational track. Given the unit costs and proportions of students in each track, it is straightforward to calculate the total costs for the 78,500 children who enter the public school system. As shown in the middle row of Table 3.1, this complement of students will require present-value expenditures of \$8.431 billion over their schooling life.

The final two columns of Table 3.1 present the new composition of students, after 4K programs have been provided. After participation in 4K, some of the 32,101 students will have shifted from the special-education and grade-repetition tracks to the regular track. This yields cost savings for these students.

Two models are presented. Models #1 and #2 differ in their assumptions about the impact of pre-k programs:

- Model #1 assumes impacts that, as reported in the published literature, are representative. So, special education is assumed to fall by 12 percent, to 13.8 percent. Grade repetition is assumed to fall by 21 percent, to 2.1 percent.
- Model #2 assumes impacts of only one-quarter as large as the average of the impacts found in earlier studies (in the literature, the average impact is not the same as the representative impact). Special education is assumed to fall by 8.5 percent, from 14.4 percent to 14.0 percent, and grade repetition is assumed to fall by 9.25 percent, from 2.3 percent to 2.2 percent. These are highly conservative impacts, given the published research.

The economic consequences of shifting the compositions of students in each track are given in the final rows of Table 3.1. Savings are generated by moving students from special education and grade repetition into the lower-cost regular track. Present-value K–12 expenditures fall to \$8.387 billion with the representative model and \$8.4 billion with the conservative model. This produces savings of approximately \$42 million or \$30 million from lower special education and \$1 million or \$0.5 million from lower grade repetition. These are substantial savings to the school system given the size of the investment.

3.3 School System Impacts: Learning-Productivity Gains

An important benefit of pre-k programs is the enhancement in academic achievement as indicated in higher test scores and greater attainment. This educational advantage is of direct benefit to students, but it should also have widespread effects on other students and the school, raising overall learning productivity. These widespread effects are probable only with pre-k programs that enroll high proportions of children; targeted or small-scale programs will not generate such widespread effects. (Also, these effects are not a function of the baseline efficiency of the schools: high-performing schools and low-performing schools will obtain benefits if their students are better prepared).

To estimate these learning productivity gains, empirical study of the Early Childhood Longitudinal Study (ECLS) dataset is performed.^x Data on whether children participated in center-based pre-k is available, both for individual children and across classes and schools. It is therefore possible to estimate the impacts for classes and schools of having a higher proportion of children who had attended pre-k.

Section 3: Fiscal Benefits to the Education System

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These estimations and the methodologies applied are explained in full in the Technical Appendix available from the authors. The overall results are that average academic achievement should rise by 0.15 standard deviations as a result of the proposed policy. In addition, the proposed 4K program would improve student behavior by 11 percent. These academic and behavioral enhancements will generate cost savings in relation to expenditures on teachers, on schools, and on the overall school system. Using data from Wisconsin Department of Public Instruction, it is possible to cost out each of these savings directly.

Teacher-related Savings: These arise because teachers positively value more proficient students and because disruptive students make working conditions less pleasant. Thus, where students are less disruptive, teachers' working conditions and overall job satisfaction will improve; this can be thought of as equivalent to a pay increase. Teacher turnover and absenteeism will fall, which saves on hiring costs (Stinebrickner, 1998) and substitute-teacher costs. Some teachers receive professional development related to student behavior; the need for these courses will be lessened. The impact of pre-k programs on teacher efficiency is especially important because payments to teachers are the largest component of the schools' budget.

School-related Savings: These savings will arise because not all the costs of low achievement and poor behavior are incurred in classrooms. For example, with lower absenteeism, schools can reduce their spending on truancy officers; with higher achievement, remedial services will be reduced. Large cost items in this domain are: security, policing, and custodial services to ensure safety within the school; substance abuse, truancy, and absenteeism operations/programs; and expenditures associated with theft and damage to property.

System-wide Savings: Some educational costs are incurred at levels above the school. For a school system, there may be a range of programs associated with student behaviors as well as expenditures in schools but paid for by the district. As examples, Wisconsin's Student Services Prevention and Wellness Team manages programs on: AIDS/HIV/STDs; classroom management and student discipline; school counseling; safe and drug-free schools; and youth-violence prevention.

Table 3.2 itemizes the cost savings that would arise from raising academic achievement by 0.15 standard deviations or student behavior by 11 percent.

Table 3.2
Learning-Productivity Cost Savings for Educational Budgets

Cost Savings from Expanded 4K Programs (\$ million)	Cohort Entering Kindergarten in 2005 with 4K for All	
	Model #1	Model #2
Teacher-related:		
Higher job satisfaction	\$ 51.33	\$ 26.55
Lower teacher turnover	\$ 18.48	\$ 9.56
Reduced need for substitute teachers	\$ 5.48	\$ 2.83
School-related:		
Improved school safety and climate	\$ 14.87	\$ 6.31
System-related:		
Reduced pressure for aid programs	\$ 7.44	\$ 3.15

Notes: Present-value figures are discounted over the child's educational span from K-12 at a discount rate of 3.5 percent. Economic values are in 2004 dollars.

Model #1 assumes that savings will apply across each child's schooling from Kindergarten through to 12th grade. It shows substantial cost savings as a result of expanding early-childhood programs. Teacher-related savings are: \$51.3 million from higher job satisfaction; \$18.5 million from lower teacher turnover; and \$5.5 million for teacher absenteeism. School-related savings are: \$14.9 million for improvements in school safety. Finally, system-related cost savings are \$7.4 million.

Model #2 uses the same modeling assumptions, but does not count any savings beyond the first six grades of schooling. Again, the savings are large, at \$26.6 million for teacher satisfaction; \$9.6 million for turnover; and \$2.8 million for substitute teachers; as well as \$6.3 million for improved safety and \$3.2 million for system-related programs.

It is important to emphasize that there are many other potential cost savings to the school system, many of which cannot be calculated because of data limitations. One example is of how student behaviors drive educational costs is substance abuse. Such abuse is strongly positively correlated with low achievement and the quality of the school environment and it imposes a considerable economic burden (CASA, 2001).^{xxi}

Overall, there are likely to be substantial savings to a school system with higher achievement and better-behaved students as a result of progression through 4K. These learning-productivity savings amount to approximately 1 to 2 percent of the overall expenditure commitment.

3.4 Cost Savings for Milwaukee

The full set of calculations for the state-level analyses may be applied to the Milwaukee school district. The main differences are that the district has higher rates of special education (16.2 percent) and grade repetition (9.2 percent) than the statewide average. (Teacher salaries are almost the same, and the learning productivity gains are assumed to be the same). Per-pupil expenditures are slightly higher than the state average also, and this difference is factored into the re-analysis.

The cost savings are summarized in Table 3.3. As with Table 3.2, the largest savings are in special education budgets and teacher satisfaction, but the sum of all the educational savings is substantial.

Table 3.3
Cost Savings for Educational Budgets for Milwaukee

Cost Savings from Expanded 4K Programs (\$ million)	Cohort Entering Kindergarten in 2005 with 4K for All	
	Model #1	Model #2
Placement-related:		
Lower special education	\$ 5.30	\$ 3.76
Lower grade retention	\$ 0.44	\$ 0.19
Teacher-related:		
Higher job satisfaction	\$ 5.16	\$ 2.67
Lower teacher turnover	\$ 1.86	\$ 0.96
Reduced need for substitute teachers	\$ 0.55	\$ 0.28
School-related:		
Improved school safety and climate	\$ 1.66	\$ 0.72
System-related:		
Reduced pressure for support programs	\$ 0.83	\$ 0.36

Notes: Present-value figures are discounted over the child's educational span from K-12 at a discount rate of 3.5 percent. Economic values are in 2004 dollars.

Section 4: Cost–Benefit Analysis

This section combines the analyses on the investment costs of 4K for all and its anticipated economic benefits. It is important to note that all that is being considered are the economic cost savings to the K-12 education system in Wisconsin, and not the gains to the individual participants and their families. This assists in making decisions as to the optimal amount of public support for pre-k. (It does, however, fall short of a complete evaluation of such provision). Both state-level and Milwaukee-level analyses are performed.

4.1 State-level Analysis

Table 4.1 reports the full economic impact analysis for 4K investments. It includes both the costs and benefits. Two cost formulas from Section Two are used; and two models of benefits from Section Three are applied: Model #1 is the ‘best estimate’ of the benefits, whereas Model #2 is contrived to produce a very low bound for the benefits.

Model A is the ‘best estimate’ of the economic impact. It assumes the representative costs of \$206.9 million for the investment, allowing for higher marginal cost and ensuring quality programs. Offsetting this cost are the benefits calculated from Model #1 assumptions. These benefits amount to \$140.96 million. The net funding requirement would, therefore, be \$65.94 million. Thus, the cost savings to the K-12 education system would offset 68 percent of the total investment in 4K for all.

Model B is extremely conservative: it assumes the representative costs of \$206.9 million, but it applies the lower-bound cost savings of Model #2 assumptions. These benefits amount to \$78.86 million. The net funding requirement is \$128.04 million. The cost savings offset 38 percent of the investment.

Model C is a plausible economic result. It assumes that high-quality programs would not increase in unit cost as demand rises; it also applies the representative set of benefits. The net result is that the cost savings almost match the investment. Under this scenario, just from the perspective of the educational economic impacts, the investment would pay for itself.

4.2 Milwaukee-level Analysis

Table 4.2 reports the full economic-impact analysis for 4K investments as applied to the Milwaukee school district. It follows the same approach as Table 4.1, but uses the Milwaukee-specific data as itemized in Sections Two and Three above. The returns are higher, mainly because pre-k programs will have a larger impact in Milwaukee.

Again, Model A is the ‘best estimate’ of the economic impact. It assumes the representative costs of \$20.69 million for the investment, allowing for higher marginal cost and ensuring quality programs. Offsetting this cost are the benefits calculated from Model #1 assumptions. These benefits amount to \$15.80 million. The net funding requirement would therefore be \$4.89 million. Thus, the cost savings to the Milwaukee district would offset 76 percent of the total investment in 4K for all.

The other two models show the lower bound (with lower benefits) and a more optimistic estimate (with lower costs). The cost offset to Milwaukee is unlikely to be below 43 percent and may even be more than sufficient to outweigh the initial investment costs entirely by 10 percent.

Table 4.1**Economic Impact Analysis of 4K for All for Wisconsin's Education System**

Present-value Figures (\$ million)	Cohort Entering Kindergarten in 2005 with 4K for All		
	[A]	[B]	[C]
4K-for-All Investment Cost (COST)	\$ 206.90	\$ 206.90	\$ 143.43
School System Cost Savings:			
Grade retention	\$ 0.95	\$ 0.42	\$ 0.95
Special education placement	\$ 42.41	\$ 30.04	\$ 42.41
Job satisfaction for teachers	\$ 51.33	\$ 26.55	\$ 51.33
Retention of teachers	\$ 18.48	\$ 9.56	\$ 18.48
Reliance on substitute teachers	\$ 5.48	\$ 2.83	\$ 5.48
Spending on school safety	\$ 14.87	\$ 6.31	\$ 14.87
Pressure on school support	\$ 7.44	\$ 3.15	\$ 7.44
Total Educational Benefits (BEN)	\$ 140.96	\$ 78.86	\$ 140.96
Net Fiscal Impact (BEN-COST)	\$ (65.94)	\$ (128.04)	\$ (2.47)
Benefit-Cost Ratio (100%*BEN/COST)	68%	38%	98%

Notes: Present-value figures are discounted over the child's educational span from K-12 at a discount rate of 3.5 percent. Economic values are in 2004 dollars. For details of cost savings, see tables in Section Three.

Table 4.2**Economic Impact Analysis of 4K for All for Milwaukee's Education System**

Present-value Figures (\$ million)	Cohort Entering Kindergarten in 2005 with 4K for All		
	[A]	[B]	[C]
4K-for-All Investment Cost (COST)	\$ 20.69	\$ 20.69	\$ 14.34
Total Educational Benefits (BEN)	\$ 15.80	\$ 8.94	\$ 15.80
Net Fiscal Impact (BEN-COST)	\$ (4.89)	\$ (11.75)	\$ 1.45
Benefit-Cost Ratio (100%*BEN/COST)	76%	43%	110%

Notes: Present-value figures are discounted over the child's educational span from K-12 at a discount rate of 3.5 percent. Economic values are in 2004 dollars. For details of cost savings, see tables in Section Three.

Section 5: Conclusion

The above analysis applies the fundamental components of an investment appraisal technique to investments in young children. This technique allows for a full consideration of the fiscal consequences of any investment. Here, a particular perspective has been adopted: that of school-district officials and education professionals who must make decisions about where to commit their resources.

Using national and state-specific data, these impacts are calculated for educational budgets across the state of Wisconsin and for Milwaukee public schools. The state already has some 4K programs, and the proposal here is to extend that opportunity to all children while also ensuring that provision is high quality. This will require a large financial commitment.

However, existing evidence indicates that, given current patterns of spending, the educational pathways students follow, and government revenue sources and expenditures, the returns to such an investment should be strongly positive. The above analysis establishes that even when a particular perspective is adopted, there are cost savings that are significant enough to offset a large proportion of the investment. (Other studies have shown cost savings also, but these studies have not been able to identify in fine detail the full array of benefits to the education system, Belfield, 2004).

Inevitably, such economic modeling requires many assumptions about impacts and costs and the accuracy of these assumptions needs to be substantiated. Given the high quality of the research evidence, and the availability of new data, it is possible to substantiate many of the assumptions about impacts. For costs data, state-specific information is applied, although budgetary information is far from perfect. To insure against inflated assumptions, a highly cautious set of assumptions are applied. Therefore, the conclusion that 4K for all will generate large cost savings appears to be robust.

Indeed, the best estimates indicate that investment in 4K for all will yield cost savings to education budgets of 68 percent (statewide) or 76 percent (Milwaukee) of the initial investment. For every dollar invested in pre-k, the education system should recoup 68 or 76 cents in terms of savings from other budgetary outlays. Therefore the financing burden for investing in pre-k will not be as great as might first be anticipated.



Endnotes

- ⁱ Nationally, programs vary in pedagogy and resource usage. The most well known is Head Start, but pre-k may be full day or half day; it may include home visits or center-based programs which involve parents; it may be a summer program or year round; teachers and centers may be licensed or accredited; programs may be universal or targeted to certain children; and the programs may be short term or sustained in duration.
- ⁱⁱ These benefits have been identified in studies by Currie (2001); Masse and Barnett (2002); Reynolds et al. (2001); Campbell and Ramey (1994, 1995); McCarton et al. (1997); Benasich et al. (1992); Johnson and Walker (1991); Henry et al. (2003); Loeb et al. (2004); Montes et al. (2003); Barnett et al. (2004); Gilliam and Zigler (2000); and Schweinhart et al. (1993). New research finds that the benefits of the High/Scope Perry Pre-School program considerably outweigh the costs when a lifetime perspective is adopted.
- ⁱⁱⁱ The model framework used here may be applied by individual districts across Wisconsin, taking account of their special education, grade retention, and school operations.
- ^{iv} NIEER (2003) lists ten benchmark criteria for establishing high-quality pre-k programs (e.g. the teacher should have a BA, with certification in early-childhood education).
- ^v This Report does not address implementation issues. School districts may need to phase in programs before full access is obtained. Selecting areas for early access may be politically sensitive, however.
- ^{vi} We appreciate information provided by Jill Haglund, Wisconsin Department of Public Instruction, for this section on the educational approaches developed across the state.
- ^{vii} In September 2001, a budget bill was set to allow districts to claim state aid for full-day, four-year-old programs. This raised concerns about the availability of funds, and the final budget sent to the governor actually called for elimination of the four-year-old kindergarten membership aid. State Superintendent Elizabeth Burmaster argued for full funding of the program and lobbied Governor Scott McCallum. This provision of the budget was vetoed by the governor, leaving four-year-old kindergarten funding intact.
- ^{viii} In 2002-2003, Wisconsin school districts with 4K programs generated about \$65 million in revenues to support their programs, of which \$44 million came from the state and \$21 million came from local revenues.
- ^{ix} Outreach activities are intended to support parents' roles as educators for their children. They are wide ranging, including: general communications, home visits, parent meetings at school, parent-education classes, parent-child activities, 4K orientation, classroom-involvement training, and participation in parent advisory committees.
- ^x For information on programs in La Crosse, a city with a comprehensive, community approach, see the June 2000 issue of *Wisconsin School News* [<http://www.dpi.state.wi.us/dpi/dlcl/bbfcsp/pdf/sandbox.pdf>]

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- ^{xi} These providers will vary in costs and effectiveness. A more complex scenario would calibrate which providers children would choose, the costs per provider type, and the costs of ensuring quality provision in each case. However, there is no definitive evidence on which providers parents would choose under an expanded system. Moreover, each type of provider would still require additional resources to upgrade their quality of provision.
- ^{xii} Set against these cost savings are the additional expenditures from students staying in school for longer. However, where these expenditures are incurred, they serve to improve outcomes as well; they are not simply additional costs.
- ^{xiii} The burden of financing for education is split across federal, state, and district agencies. In this model, each agency will obtain some savings, and this suggests that each agency should be expected to contribute to the funding of the program. For example, if a state can establish that early-childhood education is reducing special education, then it may seek to use federal dollars to provide pre-k programs. However, it is beyond the scope of this analysis to fully set out the relative contributions different agencies should make to the funding of pre-k and the political efforts necessary to ensure each agency contributes accordingly.
- ^{xiv} Participants in Oklahoma's full-access program report strong academic gains (of 16 percent) in overall language and cognitive skills tests; there are especially strong impacts for African American and Hispanic students (Gormley and Phillips, 2003). In a subsequent empirical investigation, Gormley et al. (2004) find positive academic effects for all income groups and ethnic groups on the Woodcock-Johnson achievement test. Similarly positive, but not as powerful academic effects are found in evaluations of the pre-k-for-all provision in Georgia (Henry et al., 2003).
- ^{xv} The educational benefits apply only to those children who attend public school. When the benefits are considered, those students who go into private schools will have no impact on public school efficiency. In Wisconsin, 13.6 percent of all students attend private schools (NCES, 2001, Table 22). For the educational impacts, the pertinent group is the annual entry cohort into public schools. This is 78,260 children.
- ^{xvi} Discounting is necessary because \$100 received immediately is worth more than \$100 received a decade later. The immediate \$100 could be invested in an interest-yielding account for ten years. (Discounting also reflects the certainty of money now versus the uncertainty of money later). A discount rate is applied to all money streams received in the medium term and long term, and the further away from the initial investment time, the greater the discount (Levin and McEwan, 2002). When a future benefit has been discounted, it is referred to as a present value. So, with a 5 percent discount rate, a benefit of \$105 recouped one year after the investment would have a present value of \$100.

- ^{xvii} There may also be additional costs as children stay in school for longer. However, this additional duration in school conveys benefits in later years (in terms of earnings), and children who dropout often receive public support through alternative programs.
- ^{xviii} Review of the literature indicates that reductions in the incidence of special education (SE) range from 6 percent to 48 percent, with a representative estimate of 12 percent. For studies with available costs data, SE incidence is reduced by 28 percent, 40 percent, and 43 percent (from settings where the initial incidence of SE is 12 percent, 25 percent, and 28 percent, respectively); and cost savings per child are \$2,060-\$7,996 (Currie, 2001; Masse and Barnett, 2002; Barnett, 1985).
- ^{xix} Review of this literature indicates reductions in the incidence of grade repetition range between 6 percent and 23 percent, with a representative estimate of 21 percent. For studies with costs data, reductions of 28 percent and 39 percent are found (from school systems where the grade-repetition rates are 20 percent and 38 percent, respectively); the cost savings amount to \$193-\$785 per child (Reynolds et al., 2000; Masse and Barnett, 2002).
- ^{xx} The ECLS dataset includes information on over 22,000 children across the U.S. who entered kindergarten in 1998. It also has information from their schools and their teachers (West et al., 2000). Test scores, student behaviors, and school-climate data are available (information on costs is weak, however). All this data can be linked to whether or not the child participated in center-based pre-k prior to entering kindergarten. The big advantage of the ECLS is that there is data for the students, their teachers, and their schools, allowing for a comprehensive analysis.
- ^{xxi} The educational costs associated with such abuse are: student-related (programs for at-risk children, for student assistance, and for those with substance-related learning difficulties); staff-related (administrative costs for monitoring and enforcing substance-abuse policies, training and staff development); and school-wide (drug-testing programs and special facilities for substance-abusing students, legal expenses, and property damage). CASA (2001) estimates very approximately that 10 percent of all educational expenditures are related to alcohol and substance abuse. With no direct evidence here on the link between pre-k and substance abuse, however, this impact is omitted from the analysis.

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