

# Potential Impact of Aging on the Economic Growth of Quebec

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# Overview

- Sources of economic growth: a simple model
- Measured sources: 1981-2002
- Projections: 2003-2030
  - ▶ Basic projections
  - ▶ Alternatives taking into account the likely economic impact of demographic changes
- Other considerations

# Relationship between wages and national income

Taken over a long period, the employment income growth rate is related to the growth rate of the economy (real income).

**Growth in employment income in Canada compared to GDP, annualized rates (%)**

	1961-1981	1981-2002	1961-2002
<b>Wages and other real employment income</b>	<b>4.9</b>	<b>2.6</b>	<b>3.7</b>
<b>Real gross domestic product (GDP)</b>	<b>4.6</b>	<b>2.8</b>	<b>3.7</b>

Long-term economic growth projections may therefore be used to predict growth in employment income, on which QPP contributions depend.

# Growth accounting: a simple model

$$\text{Real income} = Y = AK^\alpha L^{1-\alpha}$$

- Labour ( $L$ )
  - ▶ Total hours worked
  - ▶ Approximately 2/3 of measurable inputs ( $1-\alpha = 2/3$ )
- Capital ( $K$ )
  - ▶ Fixed non-residential capital
  - ▶ Approximately 1/3 of measurable inputs ( $\alpha = 1/3$ )
- Productivity ( $A$ )
  - ▶ Technology and organization of work
  - ▶ Residual

# Average labour gains

- Average labour gains are estimated by:

Real income ( $Y$ )

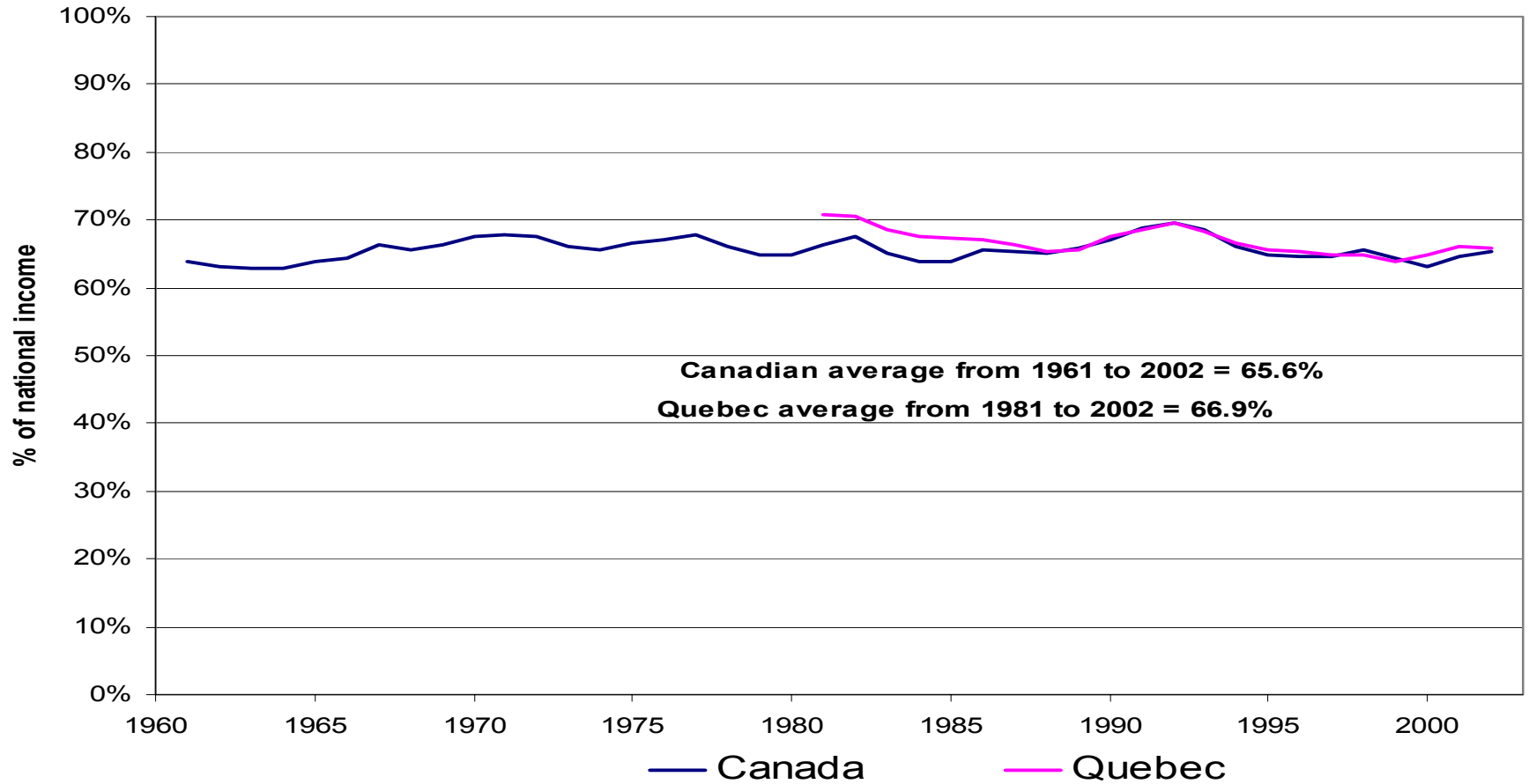
x Portion of income going to workers ( $1 - \alpha$ )

÷ Number of workers ( $N$ )

→ Corresponds approximately to labour productivity  
( $Y/N$ )

# Portion of national income paid to workers

$$(1 - \alpha) \cong 2/3$$



# Breakdown of economic growth in Quebec, 1981-2002

	Real income	Population	Population 20-64	Employment	Hours worked per week	Non-residential fixed capital	Combined inputs	Productivity
Year	1997 \$B	Millions	Millions	Millions	Millions	1997 \$B	1981=100	1981=100
1981	143.9	6.5	3.9	2.8	94.4	213.9	100.0	100.0
2002	227.3	7.5	4.7	3.6	118.8	359.7	139.7	113.1
Period	Percentage change, annualized rates							
1981-2002	2.2	0.6	0.9	1.2	1.1	2.5	1.6	0.6

	Real per capita income	Average labour earnings	Employees as % of total 20-64	Employees as % of population	Labour per capita	Capital per capita	Input per capita	Productivity
Year	1997 \$	1997 \$	%	%	Hours	1997 \$	1981=100	1981=100
1981	21,974	33,109	70.9	42.6	14.4	32,671	100.0	100.0
2002	30,485	40,608	76.1	48.2	15.9	48,251	122.7	113.1
Period	Percentage change, annualized rates							
1981-2002	1.6	1.0	0.3	0.6	0.5	1.9	1.0	0.6

# Demographic projections: summary of main assumptions

• Fertility:	2002		1.45
	2015 and after		1.65
• Net interprovincial migration	2002		-11,500
	2015 and after		-8,250
• Net international migration	2002 and after		26,500
• Life expectancy	2002	Men	75.7
		Women	81.4
	2030	Men	78.3
		Women	83.9



# Economic projections: summary of main assumptions

- Male participation rate (5-year age group)
  - ▶ Stable for 15-19 and 20-24 in 2002.
  - ▶ Slight increase for 25-64 until between 2010 and 2020, depending on age group.
  - ▶ Slight decline for 65+ until 2030.

# Economic projections: summary of main assumptions (cont'd)

- Female participation rate (5-year age group)
  - ▶ Stable for 15-19 and 20-24 in 2002.
  - ▶ Increase for 25-64 until between 2010 and 2025, depending on age group.
  - ▶ Slight increase for 65+ until 2010.

# Economic projections: summary of main assumptions (cont'd)

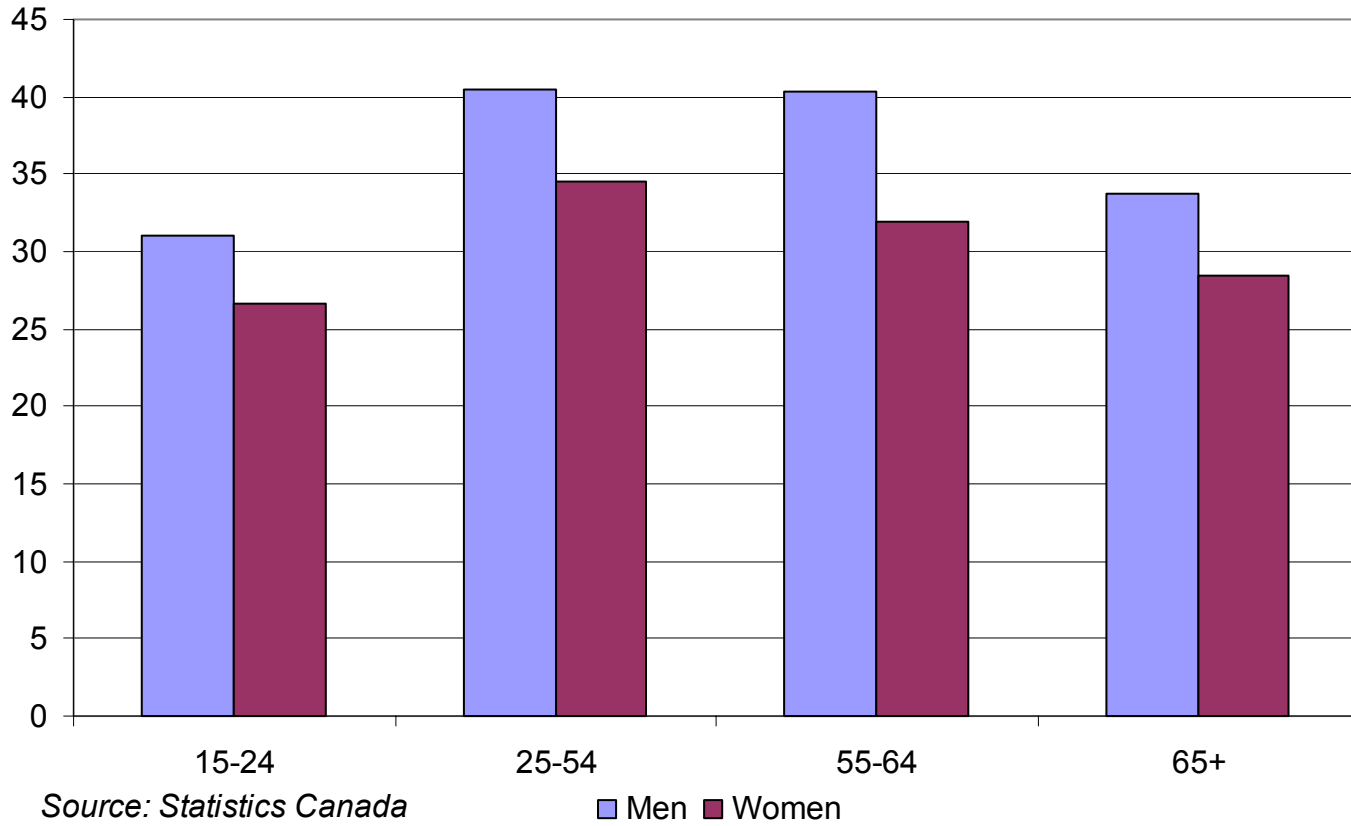
- Unemployment rate in Quebec
  - ▶ Substantial decline for all age groups to reflect employment shrinkage
  - ▶ Overall rates
    - 2002: 8.6%
    - 2003: 9.0%
    - 2010: 6.6%
    - 2020: 6.0%

# Potential impact of aging on sources of growth

- Labour ( $L$ )
  - ▶ Slower growth in working-age labour force.
  - ▶ Older workers work fewer hours on average.
- Capital ( $K$ )
  - ▶ Slower growth in income, source of saving.
  - ▶ Older households save less: life cycle assumption.
- Productivity ( $A$ )
  - ▶ Older labour potentially less productive.

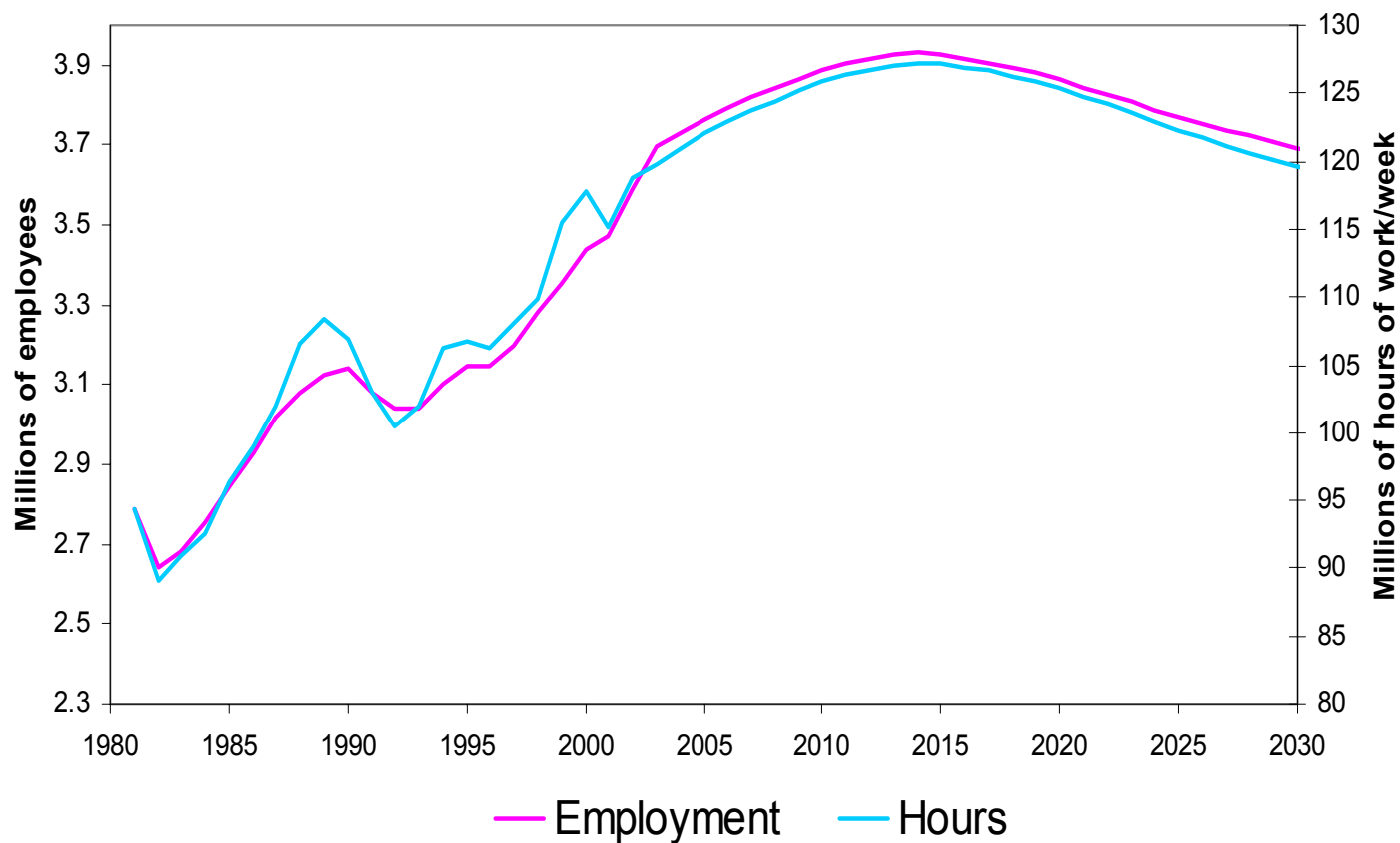
# Hours of work

**Average hours worked per week in Quebec in 2002,  
by age group**



# Labour input ( $L$ )

Employment and hours worked in Quebec, 1981-2030



# Scenario 1: Basic scenario

Reflects the impact of demographic changes on labour input, but no impact on savings and productivity growth rates (assuming historical rates).

	Real income	Population	Population 20-64	Employment	Hours worked per week	Non-residential fixed capital	Combined inputs	Productivity
Year	1997 \$B	Millions	Millions	Millions	Millions	1997 \$B	1981=100	1981=100
2002	227.3	7.5	4.7	3.6	118.8	359.7	139.7	113.1
2010	265.4	7.7	4.9	3.9	126.0	438.4	155.6	118.5
2020	302.7	7.9	4.7	3.8	124.0	552.4	167.4	125.7
2030	333.0	8.0	4.3	3.6	117.1	679.6	173.7	133.2
Period	Percentage change, annualized rates							
2002-2010	2.0	0.3	0.4	0.9	0.7	2.5	1.4	0.6
2010-2020	1.3	0.3	-0.2	-0.2	-0.2	2.3	0.7	0.6
2020-2030	1.0	0.1	-0.9	-0.6	-0.6	2.1	0.4	0.6
2002-2030	1.4	0.2	-0.3	0.0	-0.1	2.3	0.8	0.6

# Scenario 1: Basic scenario (cont'd)

	Real per capita income	Average labour earnings	Employees as % of total 20-64	Employees as % of population	Labour per capita	Capital per capita	Input per capita	Productivity
Year	1997 \$	1997 \$	%	%	Hours	1997 \$	1981=100	1981=100
2002	30,485	40,608	76.1	48.2	15.9	48,251	122.7	113.1
2010	34,691	44,235	79.3	50.3	16.5	57,304	133.2	118.5
2020	38,352	51,312	79.9	48.0	15.7	69,994	138.9	125.7
2030	41,803	59,660	82.4	45.0	14.7	85,304	142.8	133.2
Period	Percentage change, annualized rates							
2002-2010	1.6	1.1	0.5	0.5	0.4	2.2	1.0	0.6
2010-2020	1.0	1.5	0.1	-0.5	-0.5	2.0	0.4	0.6
2020-2030	0.9	1.5	0.3	-0.6	-0.7	2.0	0.3	0.6
2002-2030	1.1	1.4	0.3	-0.2	-0.3	2.1	0.5	0.6

Average labour earnings (per worker) increase more quickly than real per capita income to 1.4% on average from 2002 to 2030.



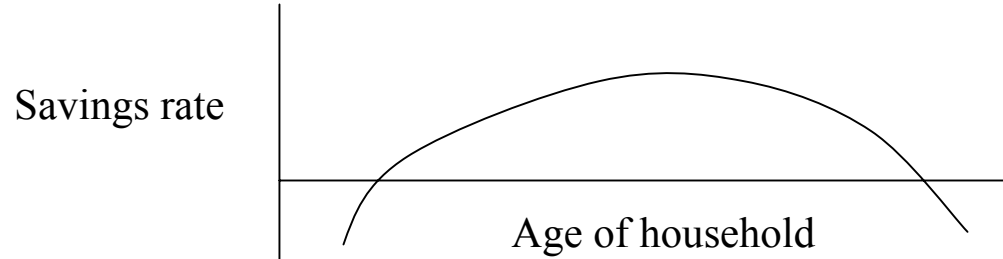
# What does 1.4% real income growth mean?

- Much lower than the 2.2% observed between 1981 and 2002.
- However, since employment does not rise, the increase in average labour gains follows the rise in total payroll and is greater in this scenario, at 1.4%, than the 1% observed from 1981 to 2002 and the 0.7 to 1.2% assumed in the QPP's last actuarial analysis.
- Scenario 1 is probably overly optimistic.

# Does an older population save less?

- Life cycle assumption

- ▶ The savings rate is shaped like a "bump" over the life of a household.

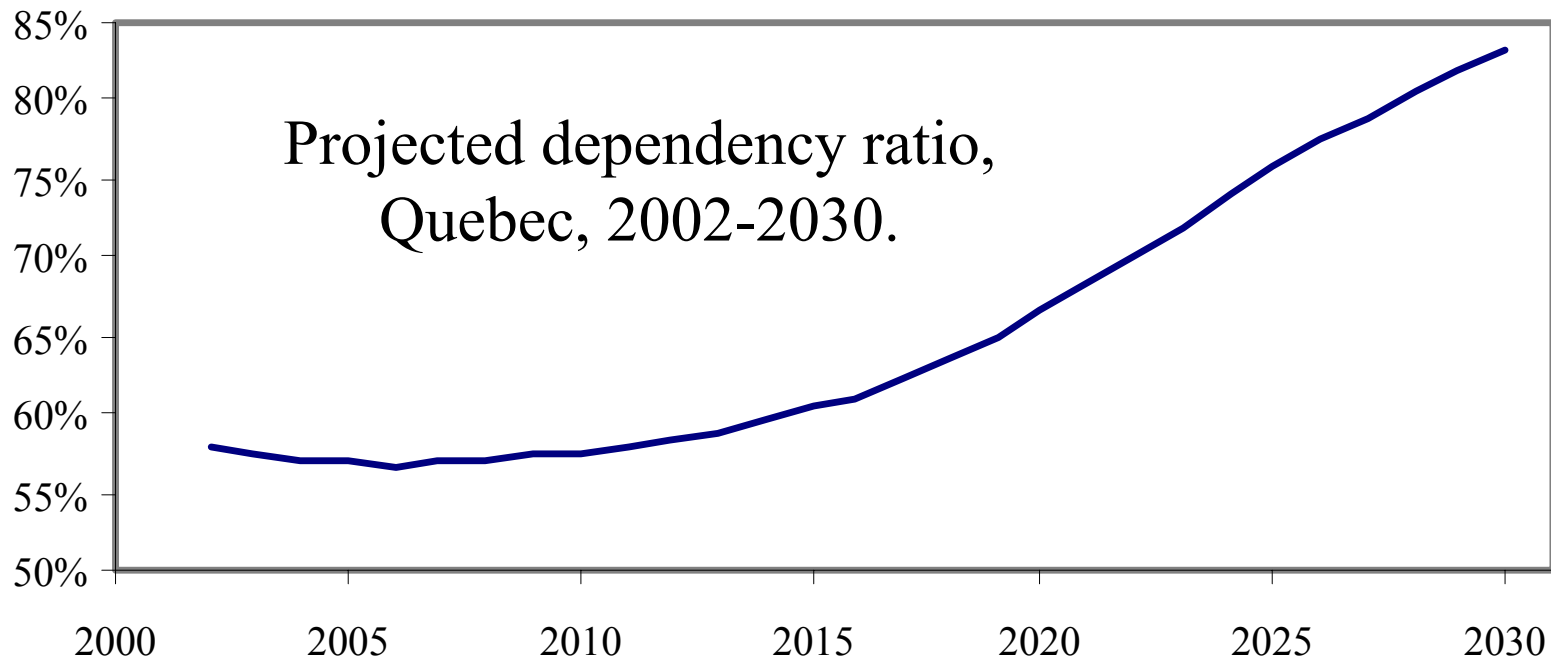


- Fougère and Mérette (1999) examine the case of Canada.

- ▶ Personal savings rate is negative for the under 25 group, then becomes positive and increases to age 54, then declines and becomes negative around ages 60-64 and remains negative and approaching zero for older individuals.

# Does an older population save less?

- Fougère and Mérette (1999)...
  - ▶ Find a negative correlation between the demographic dependency ratio (0-19 and 65+ / 20-64) and the personal aggregate savings rate.

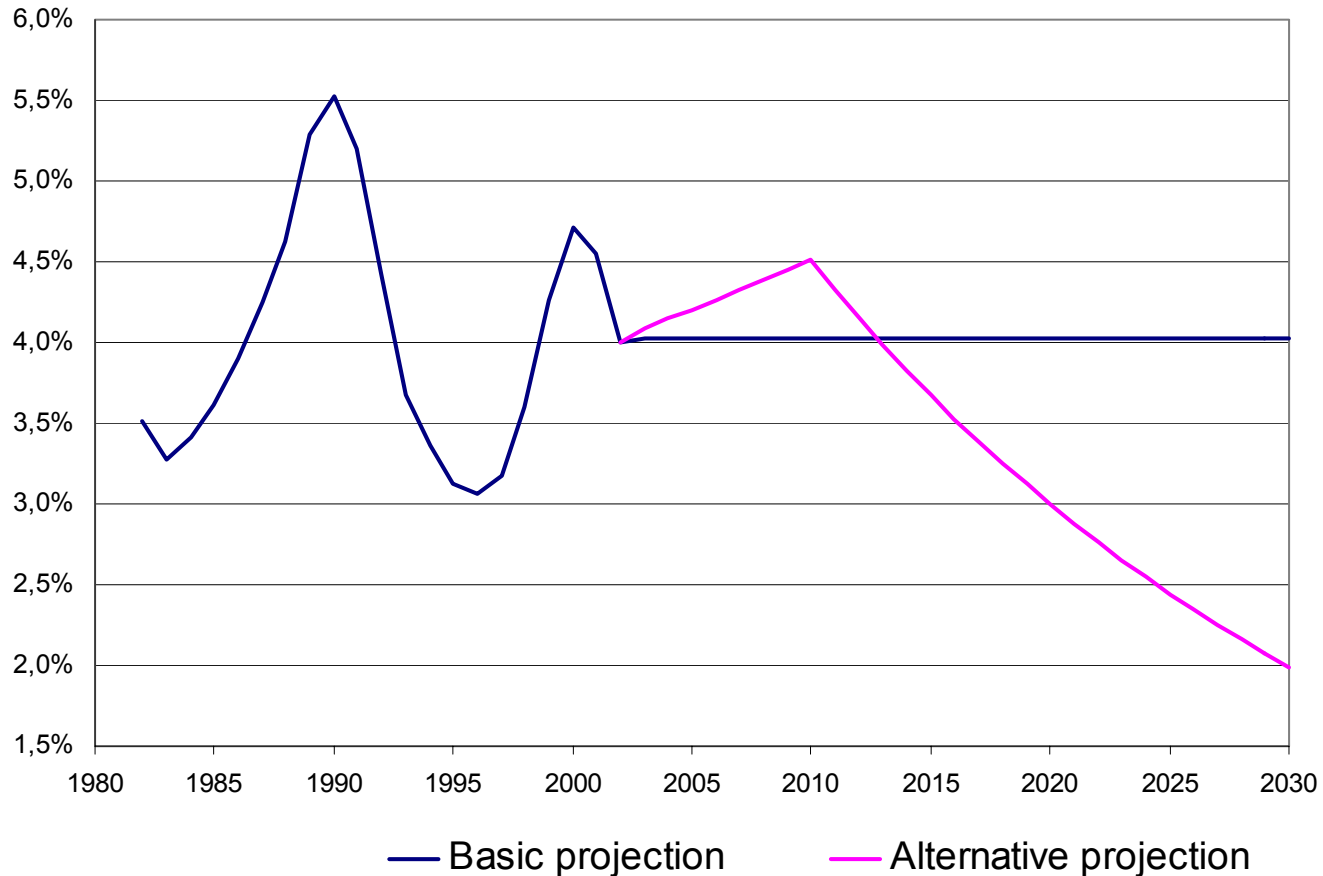


# Relationship between savings and physical capital ( $K$ )

- Historically in Canada, combined net savings of the government and foreign sectors have never been very significant.
- The savings of households and unincorporated businesses (private savings) thus finance a very large portion of fixed capital investment by businesses.
- A decline in private savings thus results in a slowdown in fixed capital formation.

# Fixed capital formation assumption

Annual addition to Quebec's non-residential fixed capital stock, as a percentage of GDP



→ the alternative projection is used in Scenarios 2 and 4.

## Scenario 2: with impact on savings rate

Reflects the impact of demographic changes on labour input and capital formation.

	Real income	Population	Population 20-64	Employment	Hours worked per week	Non- residential fixed capital	Combined inputs	Productivity
Year	1997 \$B	Millions	Millions	Millions	Millions	1997 \$B	1981=100	1981=100
2002	227.3	7.5	4.7	3.6	118.8	359.7	139.7	113.1
2010	266.6	7.7	4.9	3.9	126.0	444.0	156.4	118.5
2020	301.5	7.9	4.7	3.8	124.0	546.5	166.8	125.7
2030	322.5	8.0	4.3	3.6	117.1	571.7	168.2	133.2
Period	Percentage change, annualized rates							
2002-2010	2.0	0.3	0.4	0.9	0.7	2.7	1.4	0.6
2010-2020	1.2	0.3	-0.2	-0.2	-0.2	2.1	0.6	0.6
2020-2030	0.7	0.1	-0.9	-0.6	-0.6	0.5	0.1	0.6
2002-2030	1.3	0.2	-0.3	0.0	-0.1	1.7	0.7	0.6

# Scenario 2: with impact on savings rate (cont'd)

	Real per capita income	Average labour earnings	Employees as a % of total 20-64	Employees as % of population	Labour per capita	Capital per capita	Input per capita	Productivity
Year	1997 \$	1997 \$	%	%	Hours	1997 \$	1981=100	1981=100
2002	30,485	40,608	76.1	48.2	15.9	48,251	122.7	113.1
2010	34,848	44,435	79.3	50.3	16.5	58,030	133.8	118.5
2020	38,205	51,116	79.9	48.0	15.7	69,251	138.4	125.7
2030	40,483	57,777	82.4	45.0	14.7	77,995	138.3	133.2
Period	Percentage change, annualized rates							
2002-2010	1.7	1.1	0.5	0.5	0.4	2.3	1.1	0.6
2010-2020	0.9	1.4	0.1	-0.5	-0.5	1.8	0.3	0.6
2020-2030	0.6	1.2	0.3	-0.6	-0.7	1.2	0.0	0.6
2002-2030	1.0	1.3	0.3	-0.2	-0.3	1.7	0.4	0.6

# Would an older labour force be less productive?

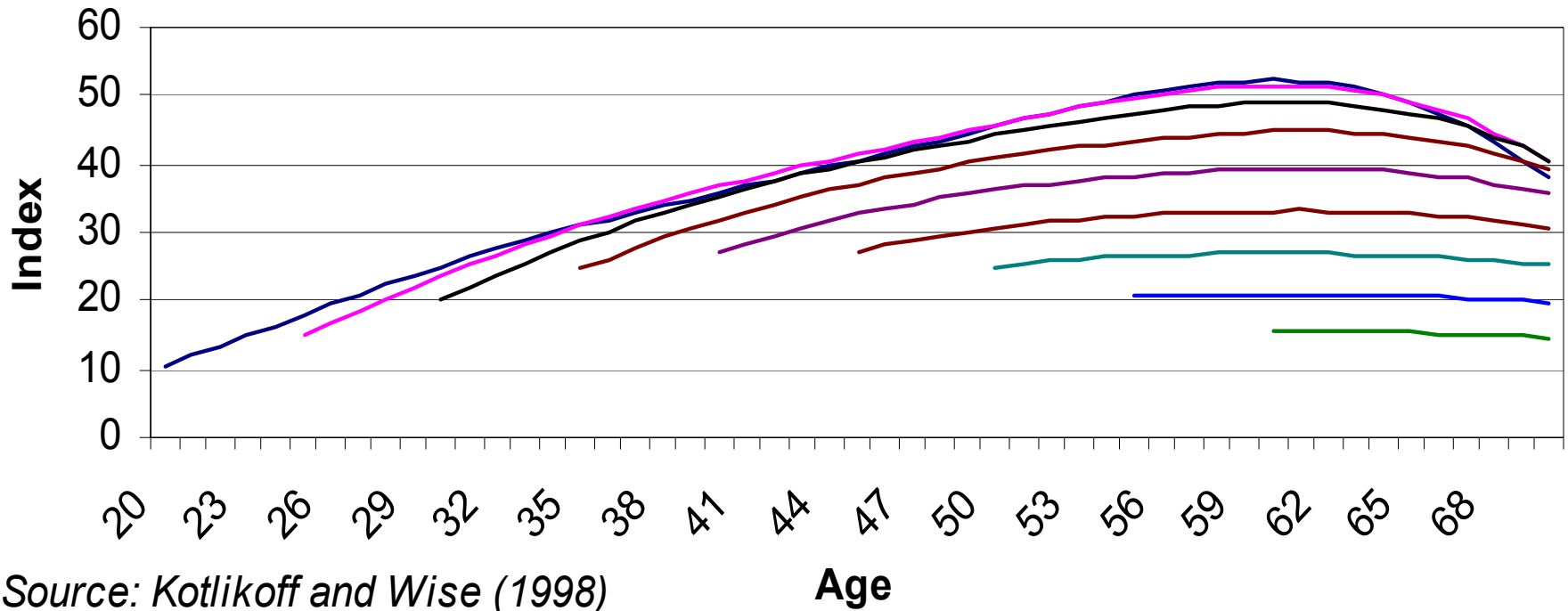
- We have (controversial) evidence from:
  - Surveys of human resources directors
  - Corporate studies (wages, sales, etc.)
  - Wage profiles by worker age
  - Econometric analyses (regressions)

... but very few rigorous formal studies on the subject.



# Wages as a productivity indicator

## Employee earnings by age and seniority

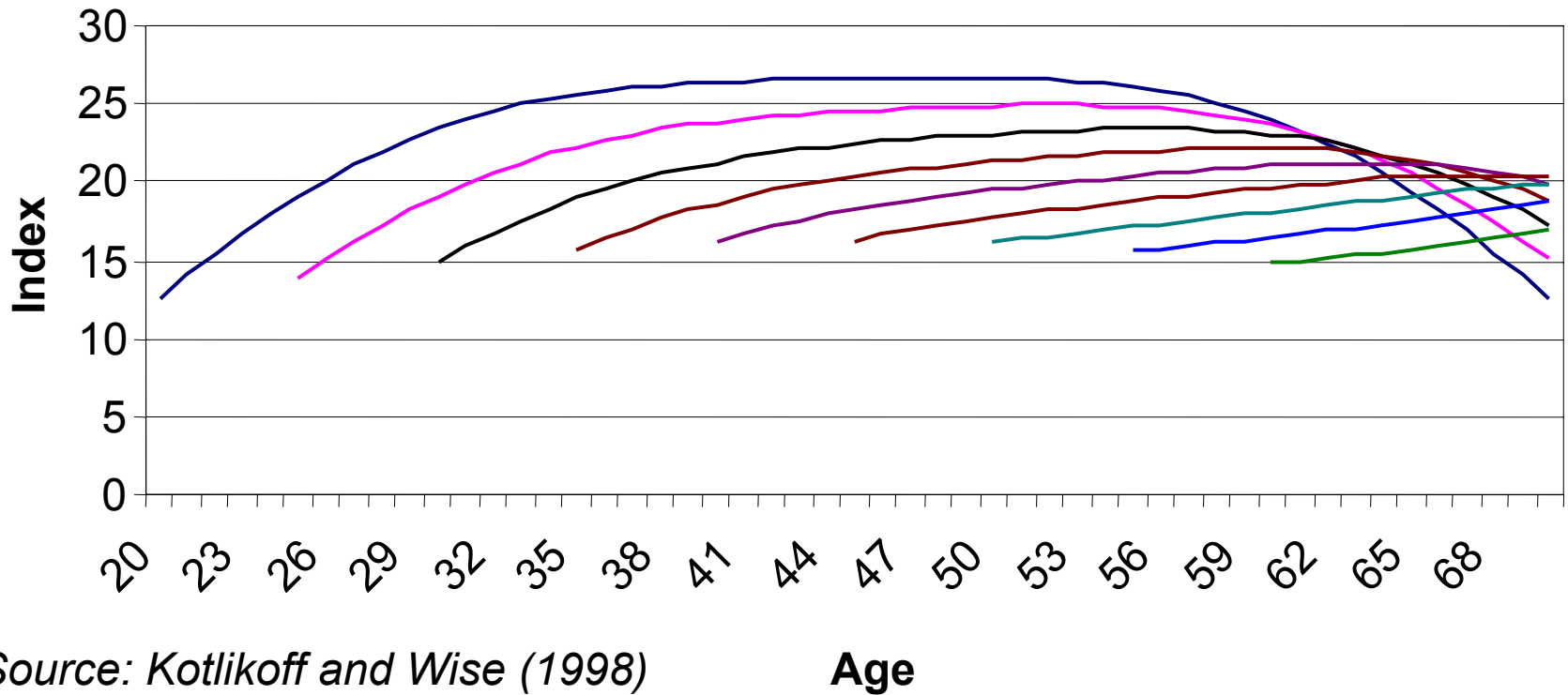


Source: Kotlikoff and Wise (1998)

Age

# Sales as a productivity indicator

## Earnings of sales persons on commission by age and seniority

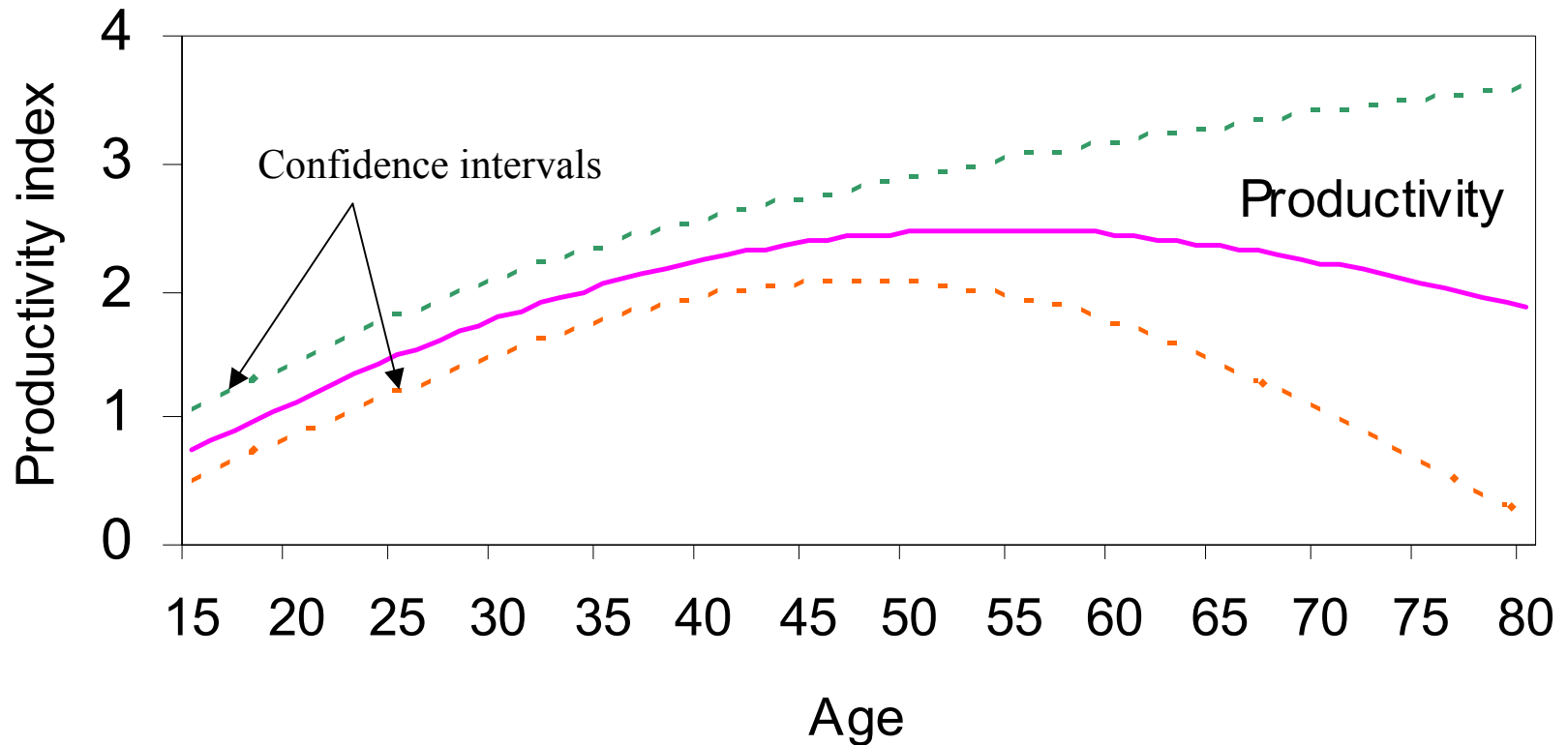


Source: Kotlikoff and Wise (1998)

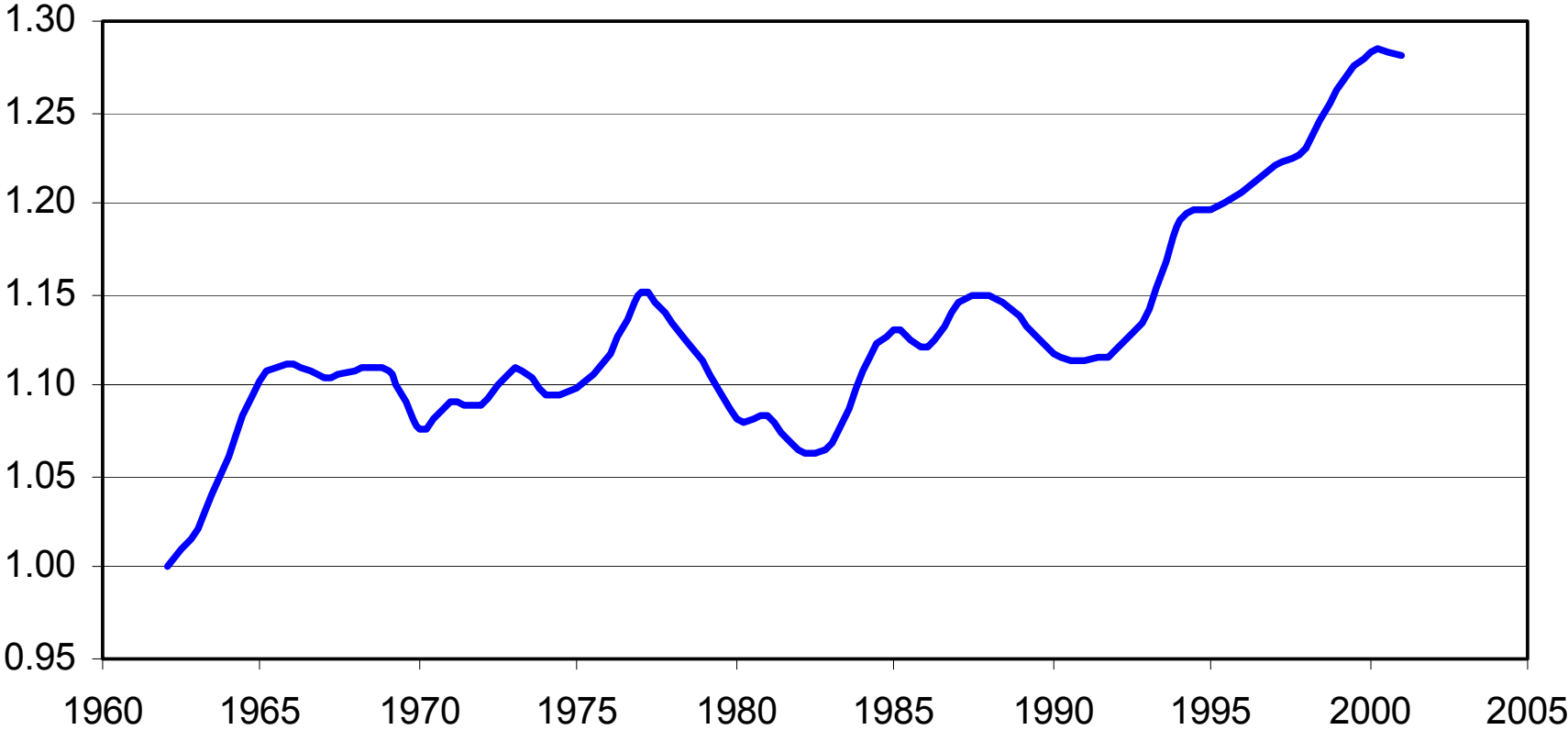
Age

# Econometric analysis - Sarel (1995)

## Productivity profile by age



# Multi-factor productivity (MFP) in Canada, 1962-2002



Source: Diewert (1999) and Statistics Canada

# Estimated equation for Canada, 1961-2002

Dependant variable: MFP

Variable	Coefficient	Stand.-dev.	t-statistic	Prob.
C	0.775615	0.536904	1.444607	0.1583
PMF(-1)	0.648260	0.122876	5.275716	0.0000
W10	<b>-0.828371</b>	0.860788	-0.962341	0.3431
W20	<b>-0.350267</b>	0.323785	-1.081787	0.2874
W30	<b>-0.641751</b>	0.852499	-0.752788	0.4571
W50	<b>0.198926</b>	1.053810	0.188769	0.8515
W60	<b>-1.490525</b>	0.993654	-1.500044	0.1434

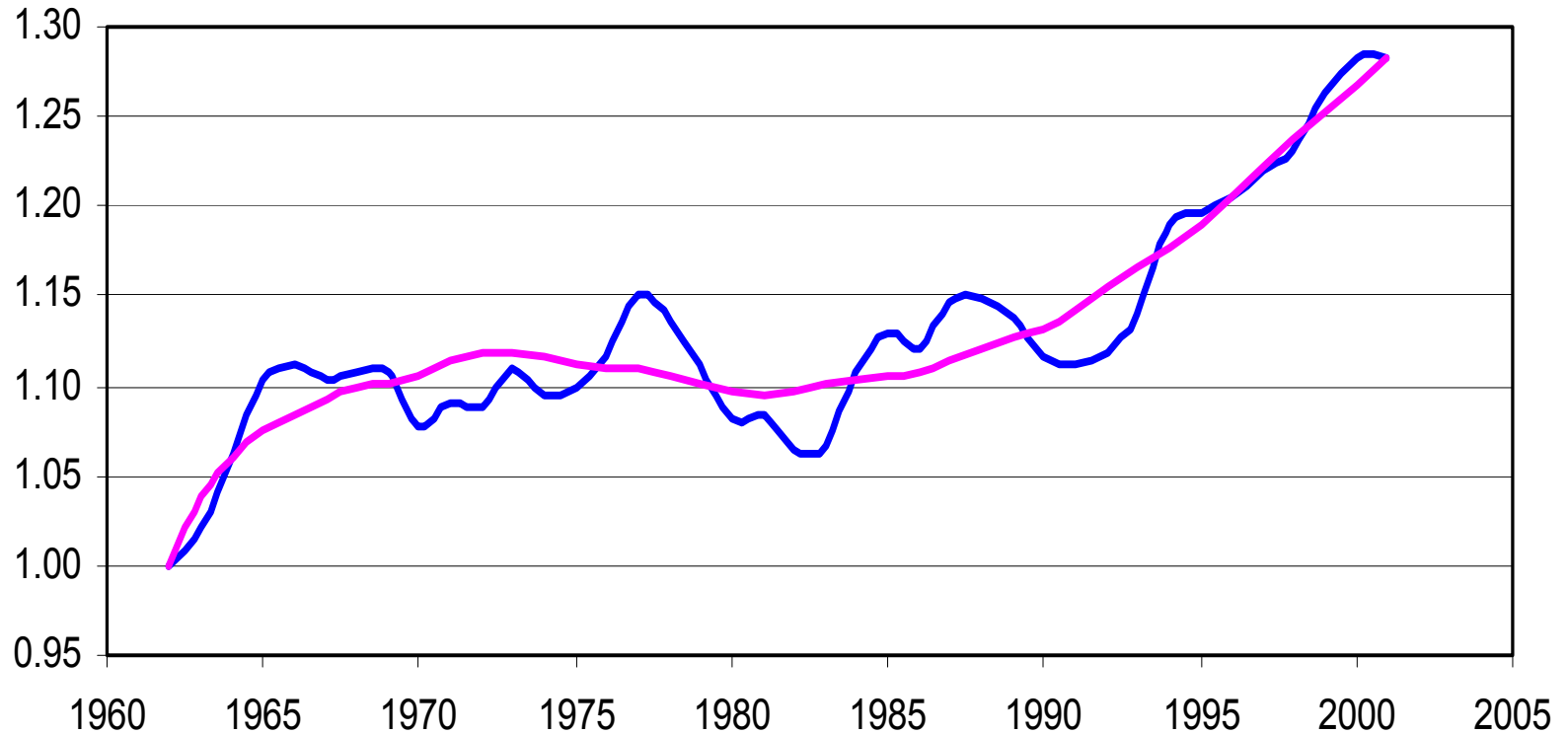
Statistical test	Value	Prob.
Obs	39	-
R <sup>2</sup> ad.	0.9102	-
Chi-2 age	15.540	0.008
RESET	0.1244	0.940
White	12.531	0.404
B-G LM	3.7347	0.155
Q-stat 1	2.0549	0.152
2	2.4593	0.292
3	3.9961	0.262
4	5.3548	0.253
Jarque-Bera	0.8978	0.638

# Comparison between results of Guillemette (2003) and Feyrer (2002)

Impact on MFP level of a transfer of 5% of workers from the first age group to the second.

Transfer from	Guillemette	Feyrer
30 to 40	7.1%	13.7%
40 to 50	2.1%	-12.5%
50 to 60	-17.1%	-16.4%

# In-sample prediction based on regression equation

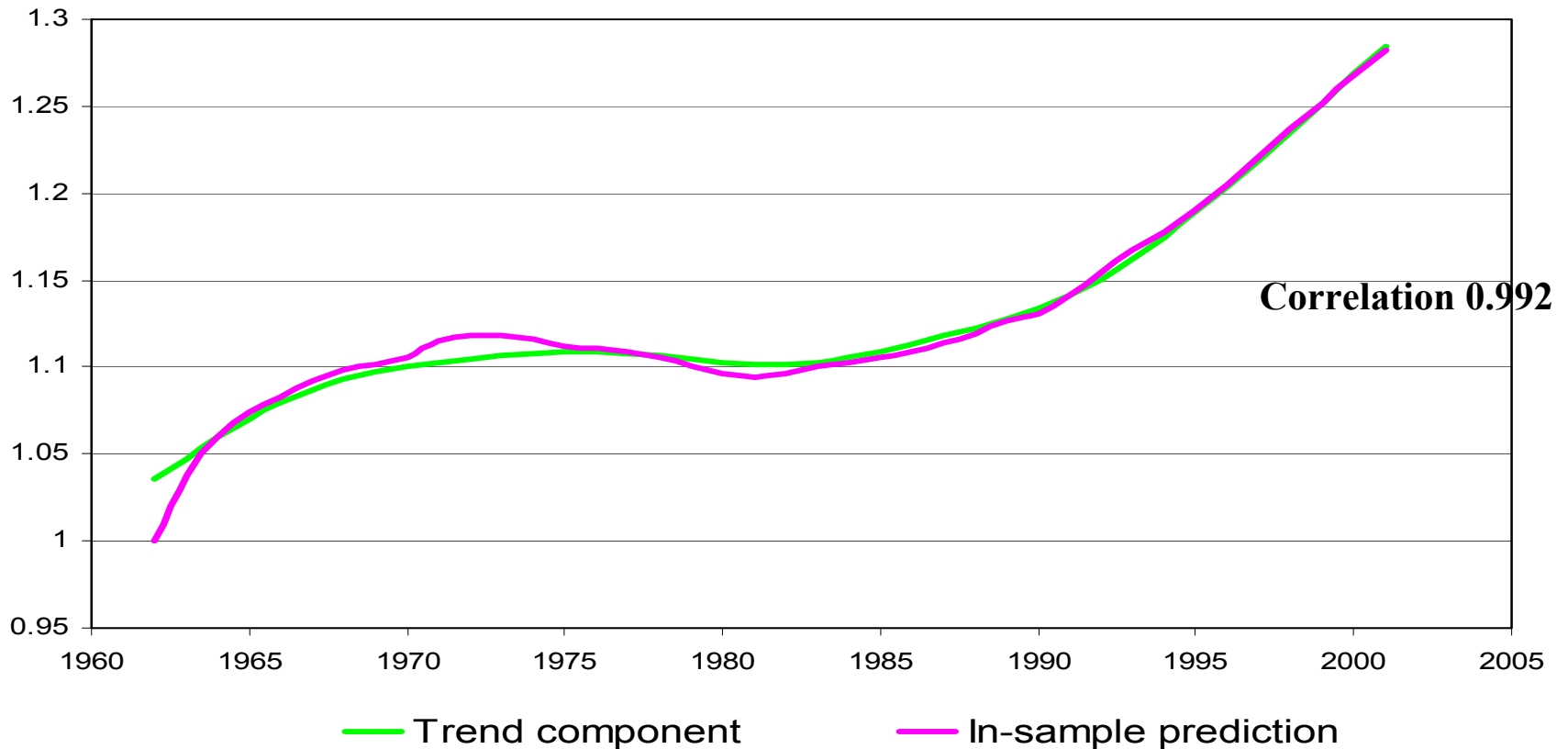


Source: Diewert (1999) and author's calculations.

— MFP — In-sample prediction

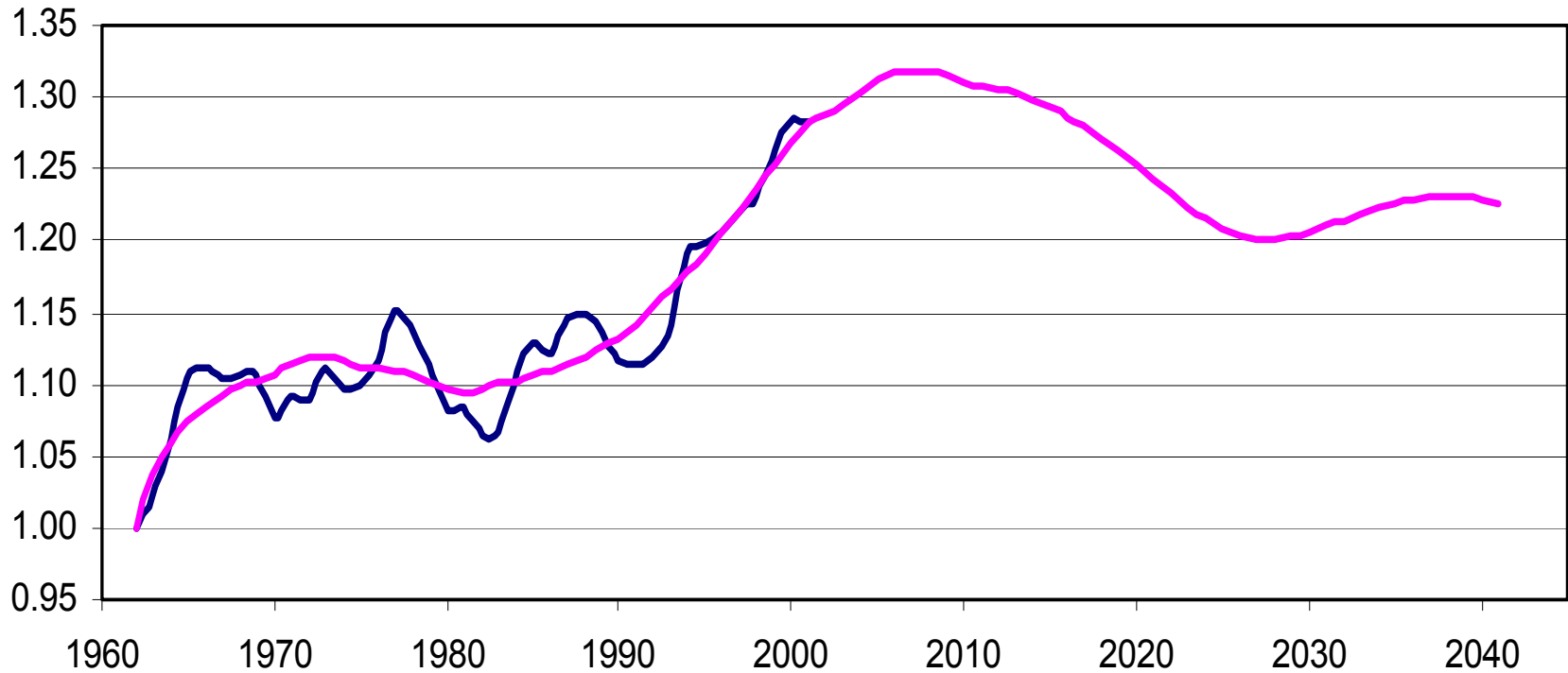
# In-sample prediction and MFP trend component

**MFP trend (HP filter) and in-sample prediction**





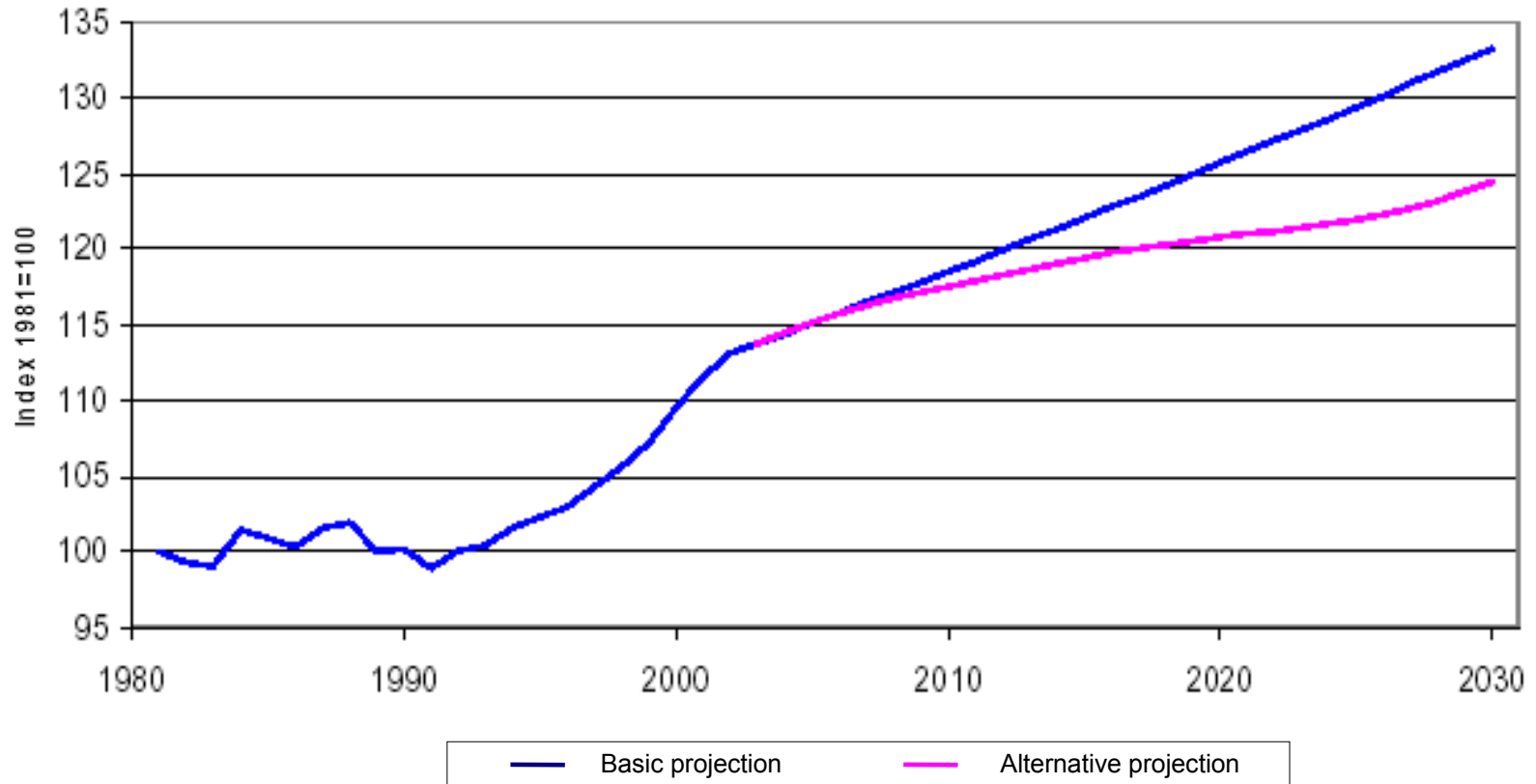
# Long-term projection of MFP, Canada (out-of-sample prediction)



Source: Diewert (1999) and author's calculations.

— MFP — Out-of-sample prediction

# Basic scenario *vs.* lower productivity growth



→ the alternative projection is used in Scenarios 3 and 4.

# Scenario 3: with impact on productivity

Reflects the impact of demographic changes on labour input and productivity level.

	Real income	Population	Population 20-64	Employment	Hours worked per week	Non- residential fixed capital	Combined inputs	Productivity
Year	1997 \$B	Millions	Millions	Millions	Millions	1997 \$B	1981=100	1981=100
2002	227.3	7.5	4.7	3.6	118.8	359.7	139.7	113.1
2010	263.1	7.7	4.9	3.9	126.0	438.3	155.6	117.5
2020	290.4	7.9	4.7	3.8	124.0	549.8	167.1	120.8
2030	309.4	8.0	4.3	3.6	117.1	585.1	172.8	124.4
Period	Percentage change, annualized rates							
2002-2010	1.8	0.3	0.4	0.9	0.7	2.5	1.4	0.5
2010-2020	1.0	0.3	-0.2	-0.2	-0.2	2.3	0.7	0.3
2020-2030	0.6	0.1	-0.9	-0.6	-0.6	0.6	0.3	0.3
2002-2030	1.1	0.2	-0.3	0.0	-0.1	1.8	0.8	0.3

# Scenario 3: with impact on productivity (cont'd)

	Real per capita income	Average labour earnings	Employees as a % of total 20-64	Employees as a % of population	Labour per capita	Capital per capita	Input per capita	Productivity
Year	1997 \$	1997 \$	%	%	Hours	1997 \$	1981=100	1981=100
2002	30,485	40,608	76.1	48.2	15.9	48,251	122.7	113.1
2010	34,391	43,853	79.3	50.3	16.5	57,289	133.2	117.5
2020	36,799	49,234	79.9	48.0	15.7	69,667	138.7	120.8
2030	38,831	55,419	82.4	45.0	14.7	84,061	142.0	124.4
Period	Percentage change, annualized rates							
2002-2010	1.5	1.0	0.5	0.5	0.4	2.2	1.0	0.5
2010-2020	0.7	1.2	0.1	-0.5	-0.5	2.0	0.4	0.3
2020-2030	0.5	1.2	0.3	-0.6	-0.7	1.9	0.2	0.3
2002-2030	0.9	1.1	0.3	-0.2	-0.3	2.0	0.5	0.3

# Scenario 4: combined impact

## Scenario with potential impact of aging on labour input, savings and productivity combined

	Real income	Population	Population 20-64	Employment	Hours worked per week	Non- residential fixed capital	Combined inputs	Productivity
Year	1997 \$B	Millions	Millions	Millions	Millions	1997 \$B	1981=100	1981=100
2002	227.3	7.5	4.7	3.6	118.8	359.7	139.7	113.1
2010	264.3	7.7	4.9	3.9	126.0	443.9	156.3	117.5
2020	289.4	7.9	4.7	3.8	124.0	544.3	166.5	120.8
2030	300.1	8.0	4.3	3.6	117.1	568.4	167.6	124.4
Period	Percentage change, annualized rates							
2002-2010	1.9	0.3	0.4	0.9	0.7	2.7	1.4	0.5
2010-2020	0.9	0.3	-0.2	-0.2	-0.2	2.1	0.6	0.3
2020-2030	0.4	0.1	-0.9	-0.6	-0.6	0.4	0.1	0.3
2002-2030	1.0	0.2	-0.3	0.0	-0.1	1.6	0.7	0.3

→ average annual income growth rate: 1% from 2002 to 2030.

# Scenario 4: combined economic impact of aging (cont'd)

	Real per capita income	Average labour earnings	Employees as a % of total 20-64	Employees as a % of population	Labour per capita	Capital per capita	Input per capita	Productivity
Year	1997 \$	1997 \$	%	%	Hours	1997 \$	1981=100	1981=100
2002	30,485	40,608	76.1	48.2	15.9	48,251	122.7	113.1
2010	34,546	44,051	79.3	50.3	16.5	58,014	133.8	117.5
2020	36,666	49,057	79.9	48.0	15.7	68,967	138.2	120.8
2030	37,664	53,753	82.4	45.0	14.7	77,191	137.8	124.4
Period	Percentage change, annualized rates							
2002-2010	1.6	1.0	0.5	0.5	0.4	2.3	1.1	0.5
2010-2020	0.6	1.1	0.1	-0.5	-0.5	1.7	0.3	0.3
2020-2030	0.3	0.9	0.3	-0.6	-0.7	1.1	0.0	0.3
2002-2030	0.8	1.0	0.3	-0.2	-0.3	1.7	0.4	0.3

→ growth rate of average earnings of approximately 1% over the entire projection period.

# What does 1% average annual growth in real income mean?

- Extremely lower than during the 1981-2002 period.
- Total payroll also increases at a rate of 1% and, once again, since employment does not rise, average earnings increase at a rate of 1%.
  - slightly lower than the 1.2% rate assumed in the last QPP actuarial report for the period after 2010.

# Comparison of the 1981-2002 historical period with the 2002-2030 projection for the 4 scenarios

Period	Hours worked per week	Non-residential fixed capital	Combined inputs	Productivity	Real income	Real per capita income	Average earnings
Percentage change, annualized rates							
1981-2002	1.1	2.5	1.6	0.6	2.2	1.6	1.0
2002-2030							
Scenario 1	-0.1	2.3	0.8	0.6	1.4	1.1	1.4
Scenario 2	-0.1	1.7	0.7	0.6	1.3	1.0	1.3
Scenario 3	-0.1	1.8	0.8	0.3	1.1	0.9	1.1
Scenario 4	-0.1	1.6	0.7	0.3	1.0	0.8	1.0

Note: Scenario 1: Impact on labour input

Scenario 2: Impacts on labour input + savings

Scenario 3: Impacts on labour input + productivity

Scenario 4: Impacts on labour input + savings + productivity



# Average earnings growth rate projections

<b>Period</b>	<b>Scenario 1</b>	<b>Scenario 2</b>	<b>Scenario 3</b>	<b>Scenario 4</b>
<b>2002-2010</b>	<b>1.1</b>	<b>1.1</b>	<b>1.0</b>	<b>1.0</b>
<b>2010-2020</b>	<b>1.5</b>	<b>1.4</b>	<b>1.2</b>	<b>1.1</b>
<b>2020-2030</b>	<b>1.5</b>	<b>1.2</b>	<b>1.2</b>	<b>0.9</b>
<b>2002-2030</b>	<b>1.4</b>	<b>1.3</b>	<b>1.1</b>	<b>1.0</b>

- The basic scenario (optimistic) predicts 1.4%, scenario 4 (quite pessimistic) 1%. The projection in the last actuarial report of 1.2% after 2010 seems justified.
- The slightly lower rates assumed by QPP for the 2002-2010 period than for after 2010 are also predicted in scenarios 3 and 4.

# Beyond the simple model used: general equilibrium effects

- To the extent that labour becomes a relatively scarce resource:
  - ▶ Wages increase → capital substitution.
    - But how can that capital be financed if saving is lower?  
External saving?
  - ▶ Physical capital relatively abundant → rate of return falls → discourages saving.
  - ▶ Rates of return on human capital investment increase → more training → increased productivity, but size of labour force reduced.

# General equilibrium effects (cont'd)

- Increased life expectancy:
  - ▶ Induces saving.
  - ▶ More work or longer retirement?
  - ▶ Flexible work arrangements and higher wages could induce baby boomers to retire later.

# General equilibrium effects (cont'd)

- How can labour force size be increased?
  - ▶ Birth rate policies? → little success
  - ▶ Immigration?
    - Limited absorption capability.
    - Immigrants find it increasingly difficult to enter the job market.

# What about investment income?

- QPP projections (2001) assume a 5.5% real return on stocks → extrapolated from historical returns.
- High historical returns came from:
  - ▶ Higher real economic growth.
  - ▶ Growth in the average P/E ratio. For the S&P/TSX index, the ratio is now approximately 21, higher than the historical average ( $\cong 15$ ).

# What about investment income?

- 1956-2002:
  - ▶ Average real return of S&P/TSX: 4.5%
  - ▶ Growth in real national income:  $> 3.5\%$
- 2002-2030
  - ▶ Forecast growth of real national income:  $< 1.5\%$
- Historical economic growth therefore supported a total real return on Canadian stocks  $> 2\%$  in the past compared to what can be expected in the future.

# How to get 5.5% on stocks?

- Over the long term, if the share of national income going to corporations remains constant, business profits will rise at the same rate as the economy in general.
- Dividend and capital gains yields must align with profit growth over the long term.
- With real economic growth of 1.4%, the only way to achieve a total return on stocks of 5.5% over the long term is for the P/E ratio to increase constantly ( $\cong 2.7\%$  per year until 2030).
- For the S&P/TSX composite index, that means that the P/E ratio would double (from approximately 22 to 44) by 2030. The problem is that, at 22, it is already higher than its historical average.

## In conclusion (cont'd)

- The possibility of slower economic growth as a result of aging must be taken seriously.
  - ▶ More work by 55+ will not be enough to compensate.
  - ▶ Japan and Germany may represent our future.
- Examine the return on investment assumption so that it corresponds with economic growth projections.
- Recognize the sensitivity of public pension plans to policies on the labour market, taxation and other regulations.



# Potential Impact of Aging on the Economic Growth of Quebec

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