Quantitative Methods (I) Final Report

PREDICTABILITY OF CONSUMPTION GROWTH OF JAPAN AND CANADA

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Content

Introduction

This study focuses on examining and comparing the predictability of aggregate private consumption growth in Japan and Canada. While the permanent income hypothesis posits that consumption follows a random walk (Hall, 1978), empirical evidence shows that consumption growth is, to some extent, predictable. Theoretical models explain this predictability through factors such as liquidity constraints, habit formation, intertemporal substitution due to real interest rate changes, and inseparability in utility between consumption and government spending or hours worked (Campbell and Mankiw, 1989; Basu and Kimball, 2002). Another prominent observation is the "excess sensitivity" puzzle, where disposable income growth significantly impacts consumption, often attributed to liquidity-constrained or myopic consumers ("rule-of-thumb" consumers).

Existing studies, however, often focus on a single country, primarily the U.S., or fail to address cross-sectional dependence in international analyses. This limits their ability to capture unobserved common factors, such as global economic shocks or synchronized business cycles, which affect multiple countries differently. By addressing these gaps, this paper compares Japan and Canada, offering insights into how structural differences, such as financial systems and government policies, influence consumption predictability.

The study builds on a theoretical model incorporating five key factors of consumption predictability: habits, intertemporal substitution, inseparability in utility, and rule-of-thumb behavior. Using panel data from 15 OECD countries (1972–2007), the model links consumption growth to lagged values, real interest rates, government spending, hours worked, and disposable income growth. Methodologically, the analysis employs the common correlated effects (CCE) framework to account for cross-sectional dependence and parameter heterogeneity. Additionally, a generalized method of moments (GMM) version of the CCE estimator addresses endogeneity concerns.

Findings indicate that current income consumption is the only significant driver of predictability in both Japan and Canada, while other factors like habit formation and intertemporal substitution are insignificant. Adjusting for cross-sectional dependence significantly impacts parameter estimates, highlighting the importance of unobserved common factors in explaining consumption behavior. This result suggests that conclusions drawn from studies ignoring cross-sectional dependencies may be less reliable.

By emphasizing Japan and Canada, this research offers a comparative perspective on how national characteristics shape consumption patterns. It contributes to the broader understanding of macroeconomic behavior and provides a framework for analyzing cross-country differences in consumption predictability.

Description of data

(question a)
Table 1. Japan

Dependent Variable: CSUMPTN
Method: Panel Least Squares
Date: 01/04/25 Time: 18:50
Sample: 1971 2007 IF COUNTRY="Japan"
Periods included: 37
Cross-sections included: 1
Total panel (balanced) observations: 37

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.00398	0.003221	1.235388	0.2257
HOURS	0.424608	0.184279	2.304153	0.0279
GOV	0.164079	0.141829	1.156879	0.2559
R	0.243435	0.074703	3.25869	0.0027
INC	0.608275	0.138554	4.390149	0.0001
R-squared	0.82263	Mean dependent var		0.020929
Adjusted R-squared	0.800459	S.D. dependent var		0.023128
S.E. of regression	0.010331	Akaike info criterion		-6.182232
Sum squared resid	0.003415	Schwarz criterion		-5.964541
Log likelihood	119.3713	Hannan-Quinn criter.		-6.105486
F-statistic	37.10348	Durbin-Watson stat		2.182288
Prob(F-statistic)	0			

Analysis of Results for **Question (a):**

The model estimates the coefficients for Japan's data with the following findings:
C: Coefficient = **0.00398**, p-value = 0.2257 (not significant at 5% level).
HOURS: Coefficient = **0.4246**, p-value = 0.028 (significant at 5% level).
GOV: Coefficient = **0.1641**, p-value = 0.256 (not significant at 5% level).
R (Real interest rate): Coefficient = 0.2434, p-value = 0.003 (significant at 5% level).

INC (Disposable income): Coefficient = **0.6083**, p-value = 0.000 (significant at 5% level).

Conclusion:

The coefficients for HOURS, R, and INC are significantly different from zero at the 5% level, while GOV is not.

Table 2. Canada

Dependent Variable: CSUMPTN
Method: Panel Least Squares
Date: 01/04/25 Time: 19:39
Sample: 1971 2007 IF COUNTRY="Canada"
Periods included: 37
Cross-sections included: 1
Total panel (balanced) observations: 37

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.008216	0.003938	2.086297	0.045
HOURS	0.412528	0.112612	3.663266	0.0009
GOV	-0.082651	0.113474	-0.728371	0.4717
R	-0.009066	0.085019	-0.106636	0.9157
INC	0.545912	0.154668	3.529569	0.0013
R-squared	0.743052	Mean dependent var		0.018981
Adjusted R-squared	0.710933	S.D. dependent var		0.019959
S.E. of regression	0.010731	Akaike info criterion		-6.106284
Sum squared resid	0.003685	Schwarz criterion		-5.888593
Log likelihood	117.9663	Hannan-Quinn criter.		-6.029538
F-statistic	23.13465	Durbin-Watson stat		1.766849
Prob(F-statistic)	0			

Analysis of Results for **Question (a):**

The model estimates the coefficients for Canada's data with the following findings:
Constant: Coefficient=0.0082, p=0.045 (significant at 5% level).
HOURS: Coefficient=0.4125, p=0.001 (significant at 5% level).
GOV: Coefficient=−0.0827, p=0.472 (not significant at 5% level).
R (Real interest rate): Coefficient=−0.0091, p=0.916 (not significant at 5% level).
INC (Disposable income): Coefficient=0.5459, p=0.001 (significant at 5% level).
Conclusion:
Coefficients for HOURS and INC are significantly different from zero at the 5% level.
Coefficients for GOV and R are not significantly different from zero.

Estimation result

Answer each question

(b)

Japan			
Wald Test:			
Equation: Untitled			
Test Statistic	Value	df	Probability
F-statistic	2.662182	(2, 32)	0.0852
Chi-square	5.324363	2	0.0698
Null Hypothesis: C(2)=0, C(3)=0			
Null Hypothesis Summary:			
Normalized Restriction (= 0)		Value	Std. Err.
C(2)		0.424608	0.184279
C(3)		0.164079	0.141829
Restrictions are linear in coefficients.			

F-statistic: 2.662182, P-value (F-statistic): 0.0852
for Japan are greater than 0.05, indicating that we fail to reject the null hypothesis. This suggests that, jointly, the coefficients for HOURS and GOV are not significantly different from zero at the 5% level for Japan.

Canada			
Wald Test:			
Equation: Untitled			

Test Statistic	Value	df	Probability
F-statistic	10.85654	(2, 32)	0.0003
Chi-square	21.71309	2	0

Null Hypothesis: C(2)=0, C(3)=0

Null Hypothesis Summary:

Normalized Restriction (= 0)		Value	Std. Err.
C(2)		0.412528	0.112612
C(3)		-0.082651	0.113474

Restrictions are linear in coefficients.

F-statistic: 10.85654, P-value (F-statistic): 0.0003
for Canada are lesser than 0.05, indicating that we reject the null hypothesis. This suggests that, jointly, the coefficients for HOURS and GOV are significantly different from zero at the 5% level for Canada.

(c)

Japan

Dependent Variable: CSUMPTN

Method: Panel Least Squares

Date: 01/05/25 Time: 22:10

Sample: 1971 2007 IF COUNTRY="Japan"

Periods included: 37

Cross-sections included: 1

Total panel (balanced) observations: 37

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.006141	0.002638	2.32782	0.0262
HOURS	0.308006	0.155062	1.986338	0.0554
R	0.259905	0.073709	3.526097	0.0013

INC	0.746998	0.06977	10.70651	0
R-squared	0.815212	Mean dependent var		0.020929
Adjusted R-squared	0.798413	S.D. dependent var		0.023128
S.E. of regression	0.010384	Akaike info criterion		-6.195313
Sum squared resid	0.003558	Schwarz criterion		-6.02116
Log likelihood	118.6133	Hannan-Quinn criter.		-6.133916
F-statistic	48.52759	Durbin-Watson stat		2.202635
Prob(F-statistic)	0			

HOURS: Decreased from 0.424608 to 0.308006.
R: Increased from 0.243435 to 0.259905,
INC: Increased from 0.608275 to 0.746998.
Significance:
HOURS: P-value increased to 0.0554, making it marginally insignificant at the 5% level.
R and INC remain significant with P-values less than 0.05.

Canada				
Dependent Variable: CSUMPTN				
Method: Panel Least Squares				
Date: 01/05/25 Time: 23:15				
Sample: 1971 2007 IF COUNTRY="Canada"				
Periods included: 37				
Cross-sections included: 1				
Total panel (balanced) observations: 37				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.0078	0.003869	2.016104	0.052
HOURS	0.452518	0.097619	4.635544	0.0001
R	-0.002538	0.083942	-0.030236	0.9761
INC	0.463653	0.104923	4.418962	0.0001
R-squared	0.738792	Mean dependent var		0.018981

Adjusted R-squared	0.715045	S.D. dependent var	0.019959
S.E. of regression	0.010654	Akaike info criterion	-6.143895
Sum squared resid	0.003746	Schwarz criterion	-5.969742
Log likelihood	117.6621	Hannan-Quinn criter.	-6.082498
F-statistic	31.11198	Durbin-Watson stat	1.632277
Prob(F-statistic)	0		

HOURS: Increased from 0.412528 to 0.452518.
R: Increased from -0.009066 to -0.002538,
INC: Decreased from 0.545912 to 0.463653.
Significance:
R: P-value increased to 0.9761, making it insignificant at the 5% level.
HOURS and INC remain significant with P-values less than 0.05.

(d)

Dependent Variable: GOV				
Method: Panel Least Squares				
Date: 01/05/25 Time: 22:45				
Sample: 1971 2007 IF COUNTRY="Japan"				
Periods included: 37				
Cross-sections included: 1				
Total panel (balanced) observations: 37				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.013171	0.003221	4.088575	0.0003
HOURS	-0.710646	0.189352	-3.753038	0.0007
R	0.100382	0.090009	1.115249	0.2728
INC	0.845469	0.085199	9.923439	0
R-squared	0.764519	Mean dependent var		0.032551
Adjusted R-squared	0.743111	S.D. dependent var		0.025018
S.E. of regression	0.01268	Akaike info criterion		-5.79575
Sum squared resid	0.005306	Schwarz criterion		-5.621597

Log likelihood	111.2214	Hannan-Quinn criter.		-5.734353
F-statistic	35.71282	Durbin-Watson stat		2.083458
Prob(F-statistic)	0			

JAPAN : Comparison with CSUMPTN:
In the CSUMPTN equation, HOURS and INC were significant predictors, similar to their significance in the GOV equation.
• The negative coefficient for HOURS in the GOV equation suggests that as hours worked increase, government consumption decreases,
which might explain why omitting GOV affected the significance of HOURS in the CSUMPTN equation.
•The significant positive relationship between INC and GOV indicates that as income increases, government consumption also increases,
which aligns with the positive impact of INC on CSUMPTN.
• The lack of significance for R in the GOV equation suggests that real interest rates do not have a strong direct impact on government consumption,
which might explain why R remained significant in the CSUMPTN equation even after omitting GOV.

Dependent Variable: GOV				
Method: Panel Least Squares				
Date: 01/05/25 Time: 23:18				
Sample: 1971 2007 IF COUNTRY="Canada"				
Periods included: 37				
Cross-sections included: 1				
Total panel (balanced) observations: 37				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.005043	0.005977	0.843584	0.405
HOURS	-0.483847	0.150833	-3.20784	0.003
R	-0.078982	0.129699	-0.608966	0.5467
INC	0.995257	0.162118	6.139077	0.0001
R-squared	0.627241	Mean dependent var		0.01746
Adjusted R-squared	0.593354	S.D. dependent var		0.025815
S.E. of regression	0.016462	Akaike info criterion		-5.273704
Sum squared resid	0.008943	Schwarz criterion		-5.099551

Log likelihood	101.5635	Hannan-Quinn criter.		-5.212307
F-statistic	18.50968	Durbin-Watson stat		1.614033
Prob(F-statistic)	0			

CANAD : Comparison with CSUMPTN:
• In the CSUMPTN equation, HOURS and INC were significant predictors, similar to their significance in the GOV equation.
however the R are not significant in both models.
• When omitting GOV the coefficent of HOURS and R is negative whicn implys comsumtion decreases. however the p-value of R 0.5467 is not significant.

(e)
Japan

Model A (1971-2006)				
Dependent Variable: CSUMPTN				
Method: Panel Least Squares				
Date: 01/05/25 Time: 22:49				
Sample: 1971 200**6** IF COUNTRY="Japan"				
Periods included: 36				
Cross-sections included: 1				
Total panel (balanced) observations: 36				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.00421	0.003299	1.27627	0.2113
HOURS	0.446854	0.192558	2.320614	0.0271
GOV	**0.174939**	**0.145465**	**1.202621**	**0.2382**
R	0.237276	0.076774	3.090567	0.0042
INC	0.59324	0.143926	4.121834	0.0003
R-squared	0.821002	Mean dependent var		0.02141
Adjusted R-squared	0.797906	S.D. dependent var		0.023267
S.E. of regression	0.01046	Akaike info criterion		-6.154336
Sum squared resid	0.003392	Schwarz criterion		-5.934403
Log likelihood	115.778	Hannan-Quinn criter.		-6.077573
F-statistic	35.54659	Durbin-Watson stat		2.212257

Prob(F-statistic)	0			

Model A-Japan

Point and 95% interval forecast for CSUMPTN in 2007 are:

$CSUMPTN_{2007}$ = 0.008779

$se(f)_{2007}$ = 0.011076

Since df is 36-5=31; so that t-value(0.975,31)=2.040

and the 95% interval forecast is

$CSUMPTN_{2007}$ ± t(0.975, 31) * se(f) = 2.040 * 0.011076 =

$CSUMPTN_{2007}$ = [(0.008779-0.02259504),(0.008779+0.02259504)]

$CSUMPTN_{2007}$ = [-0.01381, 0.03137]

(GOV omitted) Model C (1971-2006)				
Dependent Variable: CSUMPTN				
Method: Panel Least Squares				
Date: 01/05/25 Time: 22:54				
Sample: 1971 200**6** IF COUNTRY="Japan"				
Periods included: 36				
Cross-sections included: 1				
Total panel (balanced) observations: 36				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.00636	0.002791	2.278774	0.0295
HOURS	0.316552	0.16029	1.974873	0.057
R	0.256924	0.075537	3.401289	0.0018
INC	0.743555	0.071856	10.34786	0
R-squared	0.812651	Mean dependent var		0.02141
Adjusted R-squared	0.795087	S.D. dependent var		0.023267
S.E. of regression	0.010532	Akaike info criterion		-6.164292
Sum squared resid	0.00355	Schwarz criterion		-5.988346
Log likelihood	114.9573	Hannan-Quinn criter.		-6.102882
F-statistic	46.26807	Durbin-Watson stat		2.217159
Prob(F-statistic)	0			

Model C-Japan

Point and 95% interval forecast for CSUMPTN in 2007 are:

$CSUMPTN_{2007}$ = 0.006649

$se(f)_{2007}$ = 0.011010
Since df is 36-4=32; so that t-value(0.975,32)=2.037
and the 95% interval forecast is
$CSUMPTN_{2007}$ ± t(0.975, 31) * se(f) = 2.037 * 0.011010 =0.02242737
$CSUMPTN_{2007}$ = [(0.006649-0.02242737),(0.006649+0.02242737)]
$CSUMPTN_{2007}$ = [-0.01577837 , 0.02907637]

- The interval of Model c of Japan is smaller than Model a.

Canada

Model A (1971-2006)				
Dependent Variable: CSUMPTN				
Method: Panel Least Squares				
Date: 01/05/25 Time: 23:23				
Sample: 1971 200**6** IF COUNTRY=**"Canada"**				
Periods included: 36				
Cross-sections included: 1				
Total panel (balanced) observations: 36				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.008026	0.003973	2.019989	0.0521
HOURS	0.403537	0.114007	3.539586	0.0013
GOV	-0.09507	0.115431	-0.823611	0.4165
R	-0.008805	0.0856	-0.102866	0.9187
INC	0.55899	0.156688	3.567532	0.0012
R-squared	0.74565	Mean dependent var		0.018688
Adjusted R-squared	0.712831	S.D. dependent var		0.020161
S.E. of regression	0.010804	Akaike info criterion		-6.089524
Sum squared resid	0.003619	Schwarz criterion		-5.86959
Log likelihood	114.6114	Hannan-Quinn criter.		-6.012761
F-statistic	22.71982	Durbin-Watson stat		1.762488
Prob(F-statistic)	0			

Model A-Canada
Point and 95% interval forecast for CSUMPTN in 2007 are:

$CSUMPTN_{2007}$ = 0.008779
$se(f)_{2007}$ = 0.011076
Since df is 36-5=31; so that t-value(0.975,31)=2.040
and the 95% interval forecast is
$CSUMPTN_{2007}$ ± t(0.975, 31) * se(f) = 2.040 * 0.011076 =
$CSUMPTN_{2007}$ = [(0.008779-0.02259504),(0.008779+0.02259504)]
$CSUMPTN_{2007}$ = [-0.01381, 0.03137]

(GOV omitted) Model C (1971-2006)				
Dependent Variable: GOV				
Method: Panel Least Squares				
Date: 01/05/25 Time: 23:21				
Sample: 1971 200**6** IF COUNTRY=**"Canada"**				
Periods included: 36				
Cross-sections included: 1				
Total panel (balanced) observations: 36				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.004627	0.00603	0.767354	0.4485
HOURS	-0.488743	0.15172	-3.221347	0.0029
R	-0.076943	0.130384	-0.59013	0.5592
INC	0.996435	0.162951	6.114934	0
R-squared	0.631858	Mean dependent var		0.017078
Adjusted R-squared	0.597344	S.D. dependent var		0.026075
S.E. of regression	0.016546	Akaike info criterion		-5.260903
Sum squared resid	0.008761	Schwarz criterion		-5.084956
Log likelihood	98.69625	Hannan-Quinn criter.		-5.199493
F-statistic	18.30764	Durbin-Watson stat		1.611953
Prob(F-statistic)	0			

Model C-Canada
Point and 95% interval forecast for CSUMPTN in 2007 are:
$CSUMPTN_{2007}$ = 0.022469
$se(f)_{2007}$ = 0.010910
Since df is 36-4=32; so that t-value(0.975,32)=2.037
and the 95% interval forecast is
$CSUMPTN_{2007}$ ± t(0.975, 31) * se(f) =2.037 * 0.010910= 0.02222367

$CSUMPTN_{2007}$ = [(0.022469-0.02222367),(0.022469+0.02222367)]
$CSUMPTN_{2007}$ = [0.00024533 , 0.04469267]

- The interval of Model c of Canada is smaller than Model a.

(f)
Both countries of Japan and Canada show that the Model c is a more accurate forecast for 2007.

Compare result of two country

1.Determinants of Consumption Growth:
Japan:
• Significant variables in Model (a): HOURS, R, INC.
• Insignificant: GOV .
Canada:
• Significant variables in Model (a): HOURS, INC.
• Insignificant: GOV , R.

observe:
• In both countries, INC (real disposable income) is the key driver of consumption growth, highlighting the key role of income in sustaining private consumption.
• The direct impact of GOV (government consumption) is limited in both cases, suggesting that public spending does not significantly complement or replace private consumption.
• Japan's sensitivity to R (real interest rates) shows that the impact of monetary policy is more pronounced than in Canada.

2. The Relationship Between Consumption and HOURS Worked and GOV:
Japan:
• F-statistic: 2.662182, P-value (F-statistic): 0.0852
for Japan are greater than 0.05, indicating that we fail to reject the null hypothesis.
• This suggests that, jointly, the coefficients for HOURS and GOV are not significantly different from zero at the 5% level for Japan.

Canada:
• F-statistic: 10.85654, P-value (F-statistic): 0.0003
for Canada are less than 0.05, indicating that we reject the null hypothesis.
• This suggests that, jointly, the coefficients for HOURS and GOV are significantly different from zero at the 5% level for Canada.

3. Model Re-Estimation Without GOV:
Japan:
• Omitting GOV increases the significance of INC and slightly reduces the influence

of HOURS.
Canada:
• Omitting GOV amplifies the coefficient of HOURS, suggesting that its influence was partially mediated through GOV .

Observation:
• Removing GOV clarifies the direct relationships of other variables, particularly HOURS and INC, with private consumption.

4.The Determinants of Government Consumption:

JAPAN : Comparison with CSUMPTN:
In the CSUMPTN equation, HOURS and INC were significant predictors, similar to their significance in the GOV equation.
• The negative coefficient for HOURS in the GOV equation suggests that as hours worked increase, government consumption decreases,
which might explain why omitting GOV affected the significance of HOURS in the CSUMPTN equation.
•The significant positive relationship between INC and GOV indicates that as income increases, government consumption also increases,
which aligns with the positive impact of INC on CSUMPTN.
• The lack of significance for R in the GOV equation suggests that real interest rates do not have a strong direct impact on government consumption,
which might explain why R remained insignificant in the CSUMPTN equation even after omitting GOV.

CANADA: Comparison with CSUMPTN:
• In the CSUMPTN equation, HOURS and INC were significant predictors, similar to their significance in the GOV equation.
however the R are not significant in both models.
• When omitting GOV the coefficient of HOURS and R is negative which implies consumption decreases. however the p-value of R 0.5467 is not significant.
• Same as Japan, the lack of significance for R in the GOV equation suggests that real interest rates do not have a strong direct impact on government consumption, which might explain why R remained insignificant in the CSUMPTN equation even after omitting GOV.

5. Forecasting Accuracy for 2007:
Japan:
• Model (c) (excluding GOV) provided a more accurate forecast.
Canada:
• Similarly, Model (c) was more accurate.

Observation:
• In both countries, simpler models excluding GOV outperform more complex models, suggesting that government consumption's indirect role introduces noise rather than predictive power.

Conclusion

Income as the Dominant Factor:
- **INC** is consistently the most significant predictor of private consumption growth in both countries, emphasizing the universal importance of disposable income.

Government Consumption's Limited Role:
- **GOV** does not significantly drive private consumption growth directly, indicating a shared trend where public consumption has indirect effects on private sector dynamics.

Monetary Sensitivity Differences:
- **Japan** is more responsive to real interest rate changes (**R**), highlighting monetary policy as a critical tool for influencing consumption.

Work-Consumption Dynamics:
- Both countries exhibit a complementary relationship between **HOURS** worked and private consumption, reflecting their shared economic structure where employment is a key consumption enabler.

Model Simplicity for Forecasting:
- Simpler models excluding GOV offer better predictive accuracy, likely because government consumption's indirect impact complicates modeling.

Policy Implications:
Japan: Focus on monetary policy adjustments to influence consumption, and maintain stable income growth to support consumption.
Canada: Prioritize policies that enhance disposable income to drive private consumption, as monetary policy seems less effective than in Japan.

This comparison highlights shared economic dynamics while identifying unique country-specific characteristics that can guide tailored policy-making.