Rejoinder to Gu on "Estimating Capital Input for Measuring Business Sector Multifactor Productivity Growth in Canada"

Erwin Diewert[1]
University of British Columbia and University of New South Wales

ABSTRACT

This rejoinder responds to the comments of Wulong Gu (2012) on the article by Diewert and Yu (2012). The paper lays out the algebra behind the Diewert-Yu capital services methodology and the corresponding methodology used by the Statistics Canada Canadian Productivity Program. The large differences in the estimates can mainly be explained by different treatments of the expected capital gains term in user costs and the use of sectoral balancing rates of return versus economy-wide balancing rates of return.

RÉSUMÉ

Cette réplique répond aux commentaires de Wulong Gu (2012) sur l'article d'Erwin Diewert et Emily Yu (2012). L'article examine les calculs algébriques pour les méthodologies pour estimer les services de capital utilisés par Diewert-Yu et par le programme canadien de la productivité. Les grands écarts dans les estimations s'expliquent principalement par les traitements différents du terme des gains en capital escomptés dans les coûts de l'utilisation du capital et l'utilisation des taux de rendement sectoriel par rapport à a un taux de rendement a l'échelle de l'économie.

WULONG GU (2012) HAS PROVIDED a very thoughtful analysis of the differences in methodology for deriving business sector multifactor productivity (MFP) growth using the Statistics Canada Canadian Productivity Program (CPP) bottom-up methodology versus the top-down approach used by Diewert and Yu (2012). He attributes the differences in the overall MFP estimates for the Canadian business sector to the following three main factors:

- The use of the top-down approach involves some aggregation (over industries) bias which the bottom up approach does not have.
- The Diewert-Yu approach estimates a balancing or endogenous real rate of return whereas the CPP approach estimates a balancing or endogenous nominal rate of return.
- The Diewert-Yu approach is subject to some aggregation (over assets) bias that the CPP approach avoids.

1 Erwin Diewert is Professor in the Department of Economics at the University of British Columbia and at the School of Economics at the University of New South Wales. The author thanks the SSHRC of Canada for financial support for this research and he also thanks Don Drummond, Wulong Gu, Mike Harper, Alice Nakamura, Paul Schreyer and Andrew Sharpe for helpful comments. The author would also like to thank Ricardo de Avillez and the CSLS staff. None of the above are responsible for any opinions expressed in this paper. Email: diewert@econ.ubc.ca.

I actually agree with Gu on points 1 and 3 above but what Gu does not mention is that there are some problems with the Statistics Canada methodology which the Diewert-Yu methodology largely avoids. In section one, I lay out the algebra behind the two approaches and show that both approaches involve approximations to the "truth". Section two looks at the sectoral balancing rates of return used by Statistics Canada and concludes that the variability and size of these internal rates of return are the main explanation for the differences in the MFP estimates. Section three addresses some additional issues that Gu raises and section four concludes.

The Algebra Behind User Costs and Endogenous Rates of Return

In order to explain the differences between the Diewert-Yu methodology and the CPP methodology, it will be necessary to introduce some notation.

We want to work out what the value of capital services would be for a business sector that consists of I industries and where there are N assets that are used by these industries. Let P_{ni}^t denote the price of asset n in industry i at the beginning of period t and let K_{ni}^t denote the corresponding beginning of period t capital stock for n = 1,...,N and i = 1,...,I. Define the following variables:

$r_i^t \equiv$ the nominal cost of capital that industry i faces at the beginning of period t;

$\rho_{ni}^t \equiv$ the *expected* rate of price change in asset n for industry i during period t;

$\delta_{ni}^t \equiv$ the depreciation rate for asset n in industry i during period t;

$\tau_{ni}^t \equiv$ the rate of taxation (as a fraction of asset value) on asset n in industry i during period t.

Using the above definitions, the *user cost of asset n in industry i during period t*, U_{ni}^t, is defined as follows:

(1) $U_{ni}^t \equiv [r_i^t - \rho_{ni}^t + \delta_{ni}^t + \tau_{ni}^t]P_{ni}^t$; $n = 1,\ldots,N;\ i = 1,\ldots,I$.

Both Diewert and Yu and the CPP would like to construct estimates of the *total value of capital services over all assets and all industries*, $\sum_{n=1}^{N} \sum_{i=1}^{I} U_{ni}^t K_{ni}^t$, for period t. I believe that the above approach to measuring capital services is a fairly good approximation to what is international best practice methodology for the determination of the price and quantity of capital services.[2]

The two main problems with this methodology are as follows:

- It is difficult to determine precisely what the correct opportunity cost of financial capital, r_i^t, is for each industry and
- It is difficult to determine exactly how to measure the anticipated capital gains term, ρ_{ni}^t.

Diewert and Yu and the CPP solve the above two problems in different ways as we shall explain below. We first need to introduce some additional notation. Let GOS_i^t denote the gross operating surplus of industry i in period t for i = 1,...,I.[3] We can now explain the Diewert-Yu methodology. We start with the value of business sector capital services, make various simplifying assumptions about the variables defined above and set the resulting approximate value of capital services equal to the value of business sector gross operating surplus. Our key simplifying assumptions are that the nominal cost of capital is the same across industries (so that $r_i^t = r^t$ for i = 1,...,I) and that expected asset appreciation rates are the same across assets and industries (so that $\rho_{ni}^t = \rho^t$ for i = 1,...,I and n = 1,...,N). These are strong assumptions. Some additional simplifying assumptions that we will

2 The basic methodology is due to Jorgenson and Griliches (1967). See also Diewert (1980) and Schreyer (2009). There will be minor variations on the form of the user cost formula from different experts.

3 This is the value of industry i's revenues, less intermediate input cost, less labour cost.

make are: asset depreciation rates, asset prices and asset tax rates are constant across industries so that $\delta_{ni}^t = \delta_n^t$, $P_{ni}^t = P_n^t$ and $\tau_{ni}^t = \tau_n^t$ for i = 1,...,I and n = 1,...,N. Thus the Diewert-Yu value of capital services is equal to:

(2) $\sum_{n=1}^N \sum_{i=1}^I U_{ni}^t K_{ni}^t = \sum_{n=1}^N \sum_{i=1}^I [r_i^t - \rho_{ni}^t + \delta_{ni}^t + \tau_{ni}^t] P_{ni}^t K_{ni}^t$ using definitions (1)
$\approx \sum_{n=1}^N \sum_{i=1}^I [r^t - \rho^t + \delta_n^t + \tau_n^t] P_n^t K_{ni}^t$ using our simplifying assumptions
$= \sum_{n=1}^N [r^t - \rho^t + \delta_n^t + \tau_n^t] P_n^t [\sum_{i=1}^I K_{ni}^t]$
$= \sum_{n=1}^N [r^t - \rho^t + \delta_n^t + \tau_n^t] P_n^t K_n^t$ where $K_n^t \equiv \sum_{i=1}^I K_{ni}^t$
$= \sum_{i=1}^I GOS_i^t$.

Thus the approximate value of capital services is set equal to the business sector sum of the industry gross operating surpluses, which is an equation which can be solved for the *overall business sector real rate of return*, $r^t - \rho^t \equiv r^{t*}$. In our empirical work, these balancing real rates of return ranged between 2.2 per cent and 9.9 per cent with the average rate equal to 6.13 per cent. Note that the Diewert-Yu methodology has solved the problem of generating estimates for r_i^t and the expected capital gains terms ρ_{ni}^t. However, it is clear that the Diewert-Yu methodology is subject to a kind of generalized unit value bias of the type that was described by Gu (2012).[4]

I will now explain how the CPP methodology works.[5] This methodology works on a sectoral level and makes fewer simplifying assumptions. The key assumption that the CPP methodology makes is that *expected capital gains*, ρ_{ni}^t, can be approximated by ex post *actual capital gains*, π_{ni}^t for n = 1,...,N and i = 1,...,I.[6] With this simplifying assumption in hand, we can start with the industry i value of capital services, make the CPP assumption about expected capital gains and set the resulting approximate value of industry i capital services equal to the industry i gross operating surplus:

(3) $\sum_{n=1}^N U_{ni}^t K_{ni}^t = \sum_{n=1}^N [r_i^t - \rho_{ni}^t + \delta_{ni}^t + \tau_{ni}^t] P_{ni}^t K_{ni}^t$; i = 1,...,I
$\approx \sum_{n=1}^N [r_i^t - \pi_{ni}^t + \delta_n + \tau_{ni}^t] P_{ni}^t K_{ni}^t$ using the CPP simplifications
$= GOS_i^t$.

The i equations in (3) can be solved for r_i^{t*}, the industry balancing nominal rates of return.

Comparing the two methodological approaches, it would appear that the CPP bottom-up approach has a clear advantage over the top-down approach, since it makes fewer simplifying assumptions.[7] However, I have two concerns with the CPP approach:

- Assuming that expected capital gains ρ_{ni}^t can be set equal to actual ex post capital gains π_{ni}^t leads to volatile user costs and sometimes negative user costs, which in my view are not plausible. We would like user costs to approximately follow market rents and leasing rates (when available) and these actual rental rates are fairly stable and never negative.
- The balancing industry nominal rates of return r_i^{t*} generated by solving equations (3) are frequently rather extreme; i.e., negative over prolonged periods or very large indeed. Unusual rates of return cannot be regarded as good approximations to the industry's ex ante cost of capital.[8]

4 See Diewert and von der Lippe (2010) for an analysis of the magnitude of "regular" unit value bias.

5 This explanation of course applies to any MFP methodology based on the assumption discussed below.

6 Another not so important simplifying assumption that the CPP methodology makes is to assume that depreciation rates are constant across time and industries so that $\delta_{ni}^t = \delta_n$ for n = 1,...,N, i = 1,...,I and t = 1,...T. Diewert and Yu use another Statistics Canada source (CANSIM Table 310003) for depreciation rates and this alternative source does not assume that asset depreciation rates are constant over time.

7 In fact, many years ago, I advocated the type of bottom-up approach that was described above; see Diewert (1980).

It turns out that at least some of the Statistics Canada balancing rates of return seem to be published as part of the World KLEMS accounts.[9] We will look at these internal rate of return estimates in the following section.

It is easy to rework our results using an exogenous real rate of return rather than the endogenous rates of return we used. Thus if we simply assumed that the real rate of return faced by the aggregate business sector was equal to 6.13 per cent (our sample average real rate of return), then our geometric average rate of MFP growth turns out to be 1.03 per cent per year, the resulting capital services aggregate average geometric growth rate becomes 2.97 per cent per year (compared to the CPP rate of 4.81 per cent per year) and our capital stock aggregate growth rate becomes 2.33 per cent per year (compared to the CPP rate of 3.11 per cent per year). Thus the huge difference in results is not changed by assuming an exogenous real rate of return for the Diewert-Yu top-down methodology.

My summary of the issues raised above is as follows: I agree with Gu that the bottom-up approach is methodologically best, but I disagree with the use of actual capital gains to approximate expected capital gains. As we shall see in the next section, a more serious problem is the substantial sectoral measurement errors that seem to show up in the Statistics Canada estimates of the sectoral balancing nominal rates of return.

Statistics Canada Estimates of Sectoral Nominal Internal Rates of Return

World KLEMS (2012) has a table for the balancing nominal rates of return used by Statistics Canada for 30 business sector industries in Canada for the 1961-2008 period. These data, which are labelled internal rates of return (IRR), are given in three tables in the Appendix. Conceptually, these IRRs are (approximately) equal to the industry balancing nominal rates of return r_i^t that appeared in equations (3) above.

I believe that these IRRs are generally too large and too variable to represent credible nominal opportunity costs of capital for the various industries. In my view, it is these very high and variable internal rates of return that explain most of the differences between the Diewert-Yu MFP estimates and the Statistics Canada estimates. This suggests that the official sectoral MFP estimates may be subject to a considerable amount of measurement error.[10]

Additional Points

Depreciation rates: Gu (2012) noted that the CPP program uses geometric depreciation rates that were constant over the entire sample period. Other divisions at Statistics Canada appear to use variable depreciation rates, as seen in CANSIM Table 310003.[11] We also use variable rates. I think that it is quite sensible to have gradually changing depreciation rates. How-

8 The problem is that all of the measurement errors that are associated with the construction of industry accounts show up in the balancing rate of return. Measurement errors are much larger at the industry level than at business sector level. At the aggregate level, most intermediate input transactions cancel out and hence it is not particularly important that these intermediate input flows are not measured very accurately. Similar problems occur with the allocation of labour effort and capital purchases to industries; it is much easier to do these allocations at the aggregate level than at the industry level.

9 If these rates of return are reasonably accurate, these statistics would be quite important for many policy purposes. Note that our balancing rates of return were not unreasonable but of course, they cover only the entire business sector.

10 A word of caution: it is likely that the official Statistics Canada MFP estimates are based on a more detailed industry classification than was reported to the World KLEMS data base. However, it is also very likely that the more detailed IRRs are generally large and variable.

11 For example, the variable depreciation rates for computers that we obtained from CANSIM Table 310003 started at 28 per cent in 1961, moved up to 60 per cent in 1998 and drifted down to 54 per cent per year in the last year of the series.

ever, this difference in methodology is not big enough to explain the differences in results.[12] A medium term goal for Statistics Canada should be to harmonize their information on capital stocks across divisions.[13]

Different scopes: Diewert-Yu exclude all housing, including rental housing whereas the CPP business aggregate, quite properly includes it. Our reason for excluding rental housing is that there is no accurate information on the structure and land components for rental housing and so it seemed best to us to simply exclude this sector. We did not make an adjustment for the labour input into the rental sector (it will be small) so our MFP growth rate will have a small downward bias from this omission.

The Degree of Disaggregation: Gu notes that Diewert and Yu have only 14 types of reproducible asset whereas the CPP has 28. It would be useful if Statistics Canada published estimates on all 28 assets in a CANSIM Table, at least for the entire business sector. Then all researchers would have the advantages associated with the use of this expanded data base. Currently, the CPP makes available information on only 5 assets in CANSIM Table 3830025 which ends in 2008! I realize that there might be confidentiality problems in releasing data on 28 assets (plus land and inventories) by industry but there should be no problem at the business sector level.

The Land Problem: The price and quantity of business land is poorly measured both by the CPP program and by Diewert and Yu. Improvement of measurement in this area should be a priority of Statistics Canada; i.e., there is no accurate breakdown of the price and quantity of land used for business and residential housing use (the price and quantity of agricultural land is relatively well determined). Another problem with land is that approximating anticipated capital gains for the price of land by the actual ex post capital gains (as happens using the Statistics Canada methodology) can lead to small or negative user costs for land and to a weight for land in overall capital services that is too small. This will tend to (incorrectly in my view) increase the growth of capital services and decrease the rate of growth in MFP.[14]

The Computer Price Problem: Statistical agencies frequently assume very large geometric depreciation rates for computers. If the anticipated capital gains term is included in the user cost of computers, this term will frequently be quite large and will add a fairly large positive term (which essentially reflects obsolescence) into the user cost of computers. When this is combined with a large depreciation rate, there is a chance that the combined effects of depreciation and obsolescence are overdone; i.e. the user cost of computers may become too large using the geometric model of depreciation with either anticipated or actual ex post capital gains in the user cost formula.

A method for checking the reasonableness of the assumed geometric depreciation is to calculate computer capital services using the one hoss shay model. In this model, the computer is assumed to deliver the same physical capital ser-

12 One related point about depreciation that is important enough to change the results is that the Statistics Canada depreciation rates are unusually large by international standards; e.g. U.S. and Australian depreciation rates are generally much smaller. A careful audit of the Statistics Canada procedures for estimating depreciation rates seems called for.

13 The Australian Bureau of Statistics has succeeded in harmonizing their information on capital stocks, flows and depreciation back to 1960. So it can be done!

14 Even using anticipated land price change in the user cost formula can lead to a negative user cost for land services. My solution to this problem is to apply an opportunity cost principle here: the value of land services should be equal to the maximum of the user cost and the price at which the land could be rented. See Diewert (2009), Diewert and Nakamura (2009) and Diewert, Nakamura and Nakamura (2009) for more on this opportunity cost approach to estimating capital services.

vices for all years of use until it is retired.[15] The price, quantity and value of capital services can be calculated using this one hoss shay model of depreciation and then the geometric model of capital services can be calibrated to at least roughly match the one hoss shay counterpart prices, quantities and values of capital services.[16] However, this problem of computer services measurement is not big enough to explain the differences in the two sets of MFP results for Canada.

International Guidelines and Practices: Does the top-down methodology meet international guidelines for best practice in this area? I have conceded that the top-down approach is not the best approach and a bottom-up approach that had *accurate* sectoral data would be preferable.[17] However, the estimates of MFP growth generated by the CPP program are so small, indeed negative since 1977, and the Statistics Canada industry balancing nominal rates of return are so large and variable that they in my view call into question their accuracy. Gu mentions Australia as a country that follows the same methodology as Statistics Canada. However, the Australian statisticians are far from happy with this methodology: they recognize that using ex post capital gains as a proxy for expected capital gains is not the final answer and they also encountered the unusual sectoral rates of return problem.[18] The Australian Statistician, Brian Pink, in a public meeting on November 20, 2012, in Canberra told an audience that there is no universal consensus on user cost methodology and he was open to alternative ideas.

Conclusion

The article by Wulong Gu, explaining the differences between the Diewert-Yu methodology and the Statistics Canada methodology is very useful. It made clear that our methodology is not the final answer to the measurement of a nation's multifactor productivity. However, I hope that in this rejoinder I have made clear that in my view there are some issues with the Statistics Canada methodology, taking into account the accuracy of the underlying sectoral data. To address these concerns, I believe that Statistics Canada will need more resources in order to improve the quality of their sectoral estimates of inputs and outputs.

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15 The algebra of the one hoss shay model is laid out in Diewert (2005).

16 The calibration parameter would be the geometric depreciation rate; i.e. we would choose this rate so that the geometric model approximated the one hoss shay model.

17 Note that the CPP estimates of MFP for an industry could be subject to same criticisms made by Gu of the top-down method as applied to the entire business sector. Thus when Statistics Canada forms industry estimates of capital inputs, to do the job according to best practice methodology, it would need firm by firm estimates of the cost of capital. It is unlikely that this information would be available to Statistics Canada.

18 But the Australian sectoral IRRs are better behaved than the Statistics Canada sectoral IRRs.

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Appendix: List of World KLEMS Industries

The 30 industries are as follows:

1 = Agriculture, hunting, forestry and fishing;

2 = Mining and quarrying;

3 = Food products, beverages and tobacco;

4 = Textiles, textile products, leather and footwear;

5 = Wood and products of wood and cork;

6 = Pulp, paper, paper products, printing and publishing;

7 = Coke, refined petroleum products and nuclear fuel;

8 = Chemicals and chemical products;

9 = Rubber and plastics products;

10 = Other non-metallic mineral products;

11 = Basic metals and fabricated metal products;

12 = Machinery, NEC;

13 = Electrical and optical equipment;

14 = Transport equipment;

15 = Manufacturing NEC; recycling;

16 = Electricity, gas and water supply;

17 = Construction;

18 = Sale, maintenance and repair of motor vehicles and motorcycles; retail sale of fuel;

19 = Wholesale trade and commission trade, except of motor vehicles and motorcycles;

20 = Retail trade, except of motor vehicles and motorcycles; repair of household goods;

21 = Hotels and restaurants;

22 = Transport and storage;

23 = Post and telecommunications;

24 = Financial intermediation;

25 = Real estate activities;

26 = Renting of M&E and other business activities;

27 = Public administration and defence; compulsory social security;

28 = Education;

29 = Health and social work;

30 = Other community, social and personal services.

Appendix Table 1
Internal Rates of Return in Canadian Business Sector Industries (1-10), 1961-2008

	Unweighted Business Sector Average	1	2	3	4	5	6	7	8	9	10
1961	0.256	0.058	0.216	0.338	0.064	0.073	0.109	0.130	0.182	0.211	0.117
1962	0.266	0.088	0.215	0.345	0.121	0.132	0.120	0.117	0.220	0.257	0.160
1963	0.309	0.118	0.232	0.398	0.192	0.209	0.158	0.151	0.299	0.305	0.194
1964	0.285	0.083	0.245	0.403	0.181	0.213	0.149	0.141	0.229	0.339	0.201
1965	0.324	0.116	0.265	0.438	0.213	0.198	0.156	0.137	0.245	0.365	0.234
1966	0.314	0.174	0.226	0.402	0.193	0.174	0.130	0.099	0.210	0.387	0.218
1967	0.274	0.074	0.209	0.382	0.152	0.164	0.070	0.061	0.163	0.354	0.140
1968	0.273	0.069	0.179	0.344	0.173	0.264	0.052	0.032	0.149	0.406	0.156
1969	0.299	0.106	0.204	0.397	0.209	0.267	0.113	0.047	0.207	0.446	0.190
1970	0.285	0.080	0.207	0.370	0.197	0.095	0.117	0.053	0.173	0.388	0.165
1971	0.287	0.072	0.176	0.403	0.223	0.107	0.083	0.067	0.165	0.385	0.217
1972	0.283	0.111	0.173	0.382	0.205	0.254	0.079	0.066	0.155	0.365	0.243
1973	0.357	0.246	0.285	0.509	0.313	0.529	0.215	0.077	0.260	0.400	0.335
1974	0.421	0.341	0.422	0.536	0.386	0.349	0.408	0.174	0.365	0.454	0.390
1975	0.326	0.264	0.377	0.431	0.250	0.153	0.228	0.225	0.217	0.272	0.294
1976	0.256	0.177	0.312	0.398	0.196	0.135	0.151	0.068	0.132	0.218	0.205
1977	0.254	0.135	0.298	0.418	0.212	0.259	0.159	0.095	0.128	0.267	0.196
1978	0.277	0.186	0.297	0.447	0.283	0.390	0.203	0.039	0.170	0.299	0.243
1979	0.309	0.211	0.354	0.454	0.350	0.397	0.278	0.095	0.223	0.338	0.257
1980	0.301	0.187	0.390	0.422	0.372	0.209	0.313	0.131	0.225	0.327	0.226
1981	0.296	0.191	0.323	0.439	0.401	0.097	0.249	0.052	0.204	0.292	0.199
1982	0.220	0.141	0.274	0.408	0.271	-0.044	0.131	0.042	0.115	0.163	0.123
1983	0.178	0.119	0.205	0.355	0.286	0.049	0.064	0.036	0.085	0.158	0.103
1984	0.208	0.101	0.238	0.400	0.312	0.060	0.147	0.045	0.137	0.274	0.154
1985	0.231	0.098	0.213	0.459	0.347	0.134	0.153	0.040	0.172	0.350	0.223
1986	0.230	0.121	0.093	0.456	0.373	0.217	0.170	0.084	0.189	0.281	0.258
1987	0.228	0.102	0.108	0.471	0.367	0.251	0.210	0.013	0.217	0.271	0.317
1988	0.234	0.103	0.124	0.445	0.329	0.137	0.229	0.072	0.311	0.219	0.322
1989	0.227	0.135	0.112	0.444	0.349	0.152	0.188	-0.026	0.321	0.224	0.303
1990	0.180	0.132	0.116	0.437	0.268	0.048	0.113	0.013	0.246	0.194	0.199
1991	0.101	0.085	0.058	0.437	0.188	-0.036	-0.004	0.085	0.155	0.112	0.067
1992	0.135	0.135	0.034	0.478	0.229	0.088	0.025	0.004	0.180	0.214	0.107
1993	0.167	0.149	0.084	0.457	0.269	0.340	0.043	-0.005	0.210	0.272	0.126
1994	0.211	0.172	0.107	0.501	0.303	0.539	0.104	0.028	0.268	0.336	0.169
1995	0.206	0.133	0.076	0.462	0.313	0.298	0.251	0.005	0.347	0.290	0.180
1996	0.197	0.142	0.116	0.443	0.293	0.296	0.175	0.019	0.307	0.365	0.201
1997	0.212	0.132	0.094	0.463	0.350	0.358	0.154	0.020	0.290	0.342	0.238
1998	0.212	0.136	0.061	0.499	0.368	0.345	0.176	0.029	0.248	0.346	0.255
1999	0.215	0.143	0.072	0.436	0.349	0.511	0.139	0.021	0.210	0.319	0.225
2000	0.249	0.107	0.160	0.491	0.465	0.443	0.235	0.049	0.251	0.403	0.273
2001	0.223	0.122	0.115	0.518	0.370	0.382	0.233	0.105	0.232	0.426	0.296
2002	0.217	0.135	0.096	0.478	0.308	0.405	0.180	0.067	0.263	0.406	0.263
2003	0.191	0.125	0.133	0.453	0.250	0.304	0.088	0.048	0.213	0.323	0.237
2004	0.242	0.156	0.203	0.527	0.230	0.505	0.156	0.096	0.238	0.354	0.308
2005	0.236	0.146	0.237	0.527	0.146	0.352	0.159	0.080	0.191	0.362	0.326
2006	0.243	0.119	0.221	0.553	0.140	0.254	0.154	0.079	0.218	0.329	0.343
2007	0.245	0.132	0.189	0.532	0.098	0.194	0.142	0.123	0.190	0.332	0.336
2008	0.240	0.213	0.220	0.563	0.083	0.183	0.149	0.081	0.186	0.264	0.293
Period Average											
1961-2008	0.249	0.138	0.195	0.445	0.261	0.238	0.156	0.069	0.215	0.313	0.226
2000-2008	0.232	0.139	0.175	0.516	0.232	0.336	0.166	0.081	0.220	0.355	0.297

Source: World KLEMS (2012) Data: Canada, CAN Capital 2012, Released July 2012. http://www.world-klems.net/data/index.htm

Appendix Table 2
Internal Rates of Return in Canadian Business Sector Industries (11-20), 1961-2008

	11	12	13	14	15	16	17	18	19	20
1961	0.119	0.248	0.368	0.147	0.012	0.074	0.188	0.695	0.397	0.276
1962	0.143	0.349	0.564	0.216	0.019	0.072	0.139	0.658	0.396	0.258
1963	0.196	0.426	0.555	0.358	0.054	0.076	0.232	0.736	0.448	0.321
1964	0.206	0.441	0.619	0.257	0.057	0.087	0.141	0.622	0.473	0.276
1965	0.267	0.468	0.673	0.365	0.086	0.111	0.241	0.526	0.501	0.300
1966	0.216	0.438	0.604	0.250	0.114	0.097	0.288	0.482	0.581	0.354
1967	0.148	0.369	0.370	0.317	0.087	0.079	0.252	0.408	0.528	0.303
1968	0.159	0.362	0.464	0.342	0.061	0.050	0.325	0.387	0.447	0.308
1969	0.206	0.416	0.527	0.479	0.121	0.086	0.349	0.336	0.534	0.287
1970	0.184	0.324	0.431	0.217	0.117	0.101	0.485	0.362	0.579	0.351
1971	0.168	0.359	0.320	0.392	0.124	0.090	0.397	0.345	0.600	0.343
1972	0.149	0.338	0.465	0.441	0.136	0.099	0.379	0.275	0.652	0.353
1973	0.272	0.474	0.593	0.556	0.272	0.116	0.453	0.257	0.698	0.390
1974	0.371	0.600	0.642	0.535	0.324	0.230	0.682	0.319	0.826	0.447
1975	0.223	0.393	0.517	0.356	0.190	0.178	0.779	0.298	0.693	0.428
1976	0.130	0.346	0.409	0.324	0.151	0.103	0.730	0.177	0.619	0.362
1977	0.173	0.365	0.451	0.325	0.151	0.108	0.656	0.147	0.474	0.280
1978	0.229	0.480	0.439	0.379	0.194	0.124	0.629	0.168	0.463	0.352
1979	0.247	0.603	0.609	0.372	0.232	0.151	0.657	0.233	0.668	0.396
1980	0.272	0.589	0.660	0.153	0.300	0.157	0.725	0.225	0.691	0.421
1981	0.218	0.527	0.617	0.153	0.339	0.150	0.776	0.223	0.723	0.389
1982	0.076	0.335	0.448	0.158	0.206	0.109	0.728	0.190	0.508	0.313
1983	0.054	0.211	0.283	0.215	0.150	0.076	0.592	0.099	0.518	0.256
1984	0.125	0.370	0.452	0.403	0.225	0.089	0.541	0.129	0.588	0.280
1985	0.162	0.431	0.465	0.396	0.295	0.092	0.527	0.091	0.680	0.330
1986	0.144	0.464	0.384	0.228	0.238	0.103	0.522	0.059	0.752	0.311
1987	0.188	0.333	0.424	0.156	0.241	0.097	0.509	0.045	0.69	0.344
1988	0.233	0.400	0.468	0.218	0.250	0.107	0.500	0.046	0.709	0.329
1989	0.191	0.406	0.496	0.292	0.260	0.085	0.548	0.026	0.689	0.305
1990	0.086	0.349	0.405	0.201	0.212	0.101	0.43	0.010	0.580	0.254
1991	-0.01	0.151	0.231	0.107	0.085	0.044	0.306	-0.096	0.424	0.132
1992	0.019	0.209	0.248	0.160	0.156	0.047	0.349	-0.062	0.395	0.165
1993	0.064	0.326	0.339	0.231	0.181	0.086	0.338	-0.042	0.427	0.178
1994	0.137	0.401	0.378	0.343	0.265	0.109	0.352	-0.022	0.536	0.190
1995	0.192	0.472	0.386	0.363	0.280	0.087	0.266	-0.041	0.544	0.190
1996	0.162	0.450	0.364	0.304	0.296	0.109	0.267	-0.076	0.483	0.163
1997	0.214	0.506	0.468	0.280	0.361	0.101	0.251	-0.028	0.544	0.163
1998	0.229	0.467	0.452	0.322	0.404	0.103	0.240	-0.014	0.509	0.168
1999	0.216	0.486	0.603	0.540	0.380	0.084	0.219	-0.005	0.500	0.189
2000	0.287	0.592	0.615	0.514	0.512	0.093	0.233	0.038	0.520	0.230
2001	0.223	0.579	0.128	0.407	0.534	0.079	0.297	0.058	0.500	0.250
2002	0.240	0.481	0.033	0.430	0.508	0.084	0.319	0.088	0.497	0.263
2003	0.178	0.383	0.004	0.312	0.466	0.077	0.311	0.076	0.546	0.273
2004	0.288	0.507	0.105	0.241	0.550	0.116	0.421	0.106	0.641	0.292
2005	0.290	0.512	0.135	0.183	0.483	0.125	0.500	0.115	0.669	0.294
2006	0.344	0.536	0.099	0.137	0.482	0.127	0.531	0.142	0.738	0.305
2007	0.374	0.537	0.127	0.135	0.439	0.112	0.588	0.193	0.744	0.320
2008	0.354	0.490	0.131	0.092	0.429	0.107	0.610	0.214	0.641	0.301
Period Average										
1961-2008	0.195	0.423	0.408	0.298	0.251	0.102	0.433	0.192	0.574	0.291
2000-2008	0.286	0.513	0.153	0.272	0.489	0.102	0.423	0.114	0.611	0.281

Source: World KLEMS (2012) Data: Canada, CAN Capital 2012, Released July 2012. http://www.worldklems.net/data/index.htm

Appendix Table 3
Internal Rates of Return in Canadian Business Sector Industries (21-30), 1961-2008

	21	22	23	24	25	26	27	28	29	30
1961	1.000	0.089	0.042	0.878	0.153	1.000	0.027	-0.023	0.017	0.608
1962	1.000	0.093	0.049	0.733	0.146	0.956	0.026	-0.022	0.016	0.597
1963	1.000	0.115	0.056	0.788	0.167	1.000	0.052	0.015	0.058	0.597
1964	1.000	0.132	0.075	0.606	0.178	0.800	0.037	-0.007	0.029	0.563
1965	1.000	0.151	0.105	0.777	0.180	1.000	0.094	0.037	0.075	0.595
1966	1.000	0.144	0.098	0.817	0.187	1.000	0.078	0.061	0.081	0.532
1967	1.000	0.118	0.115	0.814	0.174	1.000	0.013	0.040	0.068	0.481
1968	0.996	0.102	0.108	0.841	0.133	1.000	0.014	0.002	0.050	0.413
1969	0.924	0.138	0.123	0.762	0.161	0.889	0.049	0.063	0.101	0.456
1970	0.938	0.140	0.123	0.821	0.151	0.902	0.049	0.061	0.102	0.410
1971	0.912	0.139	0.119	0.828	0.172	0.929	0.067	0.065	0.129	0.393
1972	0.773	0.148	0.115	0.726	0.191	0.783	0.065	0.043	0.133	0.390
1973	0.717	0.163	0.116	0.605	0.257	0.791	0.123	0.195	0.282	0.407
1974	0.819	0.246	0.158	0.577	0.257	0.782	0.268	0.185	0.282	0.495
1975	0.620	0.210	0.164	0.607	0.148	0.649	0.124	0.083	0.183	0.381
1976	0.444	0.132	0.120	0.559	0.154	0.564	0.073	0.056	0.174	0.291
1977	0.418	0.143	0.126	0.589	0.112	0.516	0.077	0.077	0.169	0.279
1978	0.409	0.147	0.238	0.557	0.132	0.442	0.082	0.070	0.174	0.296
1979	0.412	0.182	0.134	0.462	0.151	0.439	0.096	0.124	0.205	0.309
1980	0.416	0.179	0.071	0.383	0.158	0.360	0.124	0.119	0.262	0.291
1981	0.393	0.166	0.121	0.461	0.193	0.465	0.151	0.103	0.289	0.294
1982	0.301	0.141	0.174	0.302	0.106	0.449	0.09	0.092	0.251	0.254
1983	0.179	0.091	0.136	0.334	0.120	0.312	0.051	0.007	0.200	0.158
1984	0.171	0.098	0.124	0.235	0.116	0.306	0.045	-0.008	0.157	0.178
1985	0.203	0.117	0.127	0.276	0.111	0.270	0.035	0.026	0.174	0.212
1986	0.209	0.106	0.130	0.358	0.153	0.307	0.026	0.038	0.207	0.243
1987	0.180	0.104	0.107	0.322	0.172	0.226	0.021	0.061	0.209	0.218
1988	0.178	0.117	0.106	0.307	0.137	0.219	0.053	0.072	0.210	0.228
1989	0.183	0.116	0.100	0.247	0.128	0.172	0.053	0.080	0.234	0.227
1990	0.152	0.095	0.106	0.209	0.066	0.144	0.051	0.049	0.206	0.194
1991	0.048	0.060	0.049	0.135	0.099	0.041	-0.005	-0.016	0.153	0.105
1992	0.093	0.069	0.096	0.253	0.080	0.096	0.022	0.020	0.190	0.155
1993	0.097	0.076	0.114	0.317	0.096	0.105	0.020	0.029	0.184	0.163
1994	0.109	0.103	0.119	0.375	0.095	0.114	0.040	0.040	0.204	0.176
1995	0.136	0.085	0.100	0.359	0.070	0.125	0.040	0.050	0.213	0.187
1996	0.107	0.100	0.146	0.332	0.067	0.109	0.046	0.036	0.199	0.163
1997	0.104	0.093	0.123	0.302	0.087	0.159	0.037	0.037	0.235	0.171
1998	0.113	0.079	0.116	0.252	0.081	0.163	0.026	0.030	0.236	0.164
1999	0.124	0.064	0.083	0.161	0.093	0.124	0.033	0.026	0.224	0.164
2000	0.149	0.077	0.083	0.183	0.091	0.126	0.049	0.055	0.252	0.201
2001	0.138	0.069	0.082	0.179	0.091	0.137	0.013	0.036	0.230	0.224
2002	0.137	0.070	0.082	0.171	0.105	0.143	0.023	0.023	0.210	0.238
2003	0.131	0.056	0.061	0.178	0.110	0.110	0.034	0.030	0.200	0.230
2004	0.167	0.073	0.115	0.223	0.118	0.127	0.050	0.063	0.236	0.271
2005	0.155	0.106	0.140	0.231	0.100	0.130	0.058	0.055	0.213	0.276
2006	0.165	0.117	0.189	0.270	0.124	0.127	0.073	0.077	0.203	0.273
2007	0.187	0.098	0.210	0.291	0.121	0.128	0.059	0.090	0.235	0.264
2008	0.181	0.112	0.240	0.296	0.077	0.146	0.093	0.099	0.232	0.241
Period Average										
1961-2008	0.423	0.116	0.117	0.444	0.133	0.435	0.059	0.053	0.179	0.305
2000-2008	0.157	0.086	0.134	0.225	0.104	0.130	0.050	0.059	0.223	0.246

Source: World KLEMS (2012) Data: Canada, CAN Capital 2012, Released July 2012. http://www.world-klems.net/data/index.htm