Some Comments on "Explaining Productivity Trends in Canada" by Wulong Gu from **Statistics Canada**

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What Was discussed? Recent Data Experiments and Extensions

- My take:
 - Lots of good work here but still much work to be done by academics. Need for a refocus on the connect to underlying microeconomic theory on technology and markets structures.
 - Statistics Canada should provides more ready access to all microdata in line with much current work in the field (Chandra, Finkelstein, Sacarny, and Syverson and consistent with the scientific methodology of reproducibility.
 - Statistics Canada needs to describe in detail the exact methodology used to produce the underlying data that the productivity group uses and needs a longer consistent time series at disaggregated levels.
 - More focus on management capabilities at the establishment and corporate level. "A good entrepreneur/manager is hard to find !!!"
 - **Much** of the work undertaken here was anticipated and more fully investigated in a conceptual sense some 40 years ago in a paper arising out of work carried out for Statistics Canada.

Denny, M. and J.D. May "**Report on the Measurement of Real Output and the Implications for Measuring Productivity Growth and Technical Progress**" unpublished manuscript, December 1974, Edited January 1998. (<u>www.mun.ca/care/DENNY.pdf</u>)

Recent Experiments and Extensions in Statistics Canada?

- Endogenous or exogenous rates of return?
- Expanding Asset Coverage
 - intangible capital
 - ➢Infrastructure capital
 - ➢Natural capital
 - ➢Utilization rates of capital
- MFP by end products
- Experimental measures: output and productivity measures in the public sector.

Growth Accounting Framework

• MFP: Stats Can follows Jorgenson in return U.S. Dep't of Agriculture followed Denny. A story

- SC has moved from productivity measures based only on real value-added (VQ) and labour inputs to also those based on gross output (Q). Although empirical evidence often rejects value-added productivity as a measure of technical progress because of rejection of a <u>separability</u> assumption. Following the OECD two measures are said to be complementary.
- On p. 14, Denny has a lot to say about double-deflation and real value-added. "If the production technology is <u>additively separable</u> then double deflation is the correct procedure." and this "requires that materials and real value-added are perfect substitutes in production." Gross output "could be produced with either materials or real value-added alone."
- Irony.. While SC quotes Bruno about the gross output/ real value-added issue it does not refer to Denny and May who also published a paper in Fuss and McFadden dealing with the same issue AND offering direct empirical evidence as to the structure of the underlying production technology.
- Why do statistics agencies still adhere to this methodology? Denny "One might conclude that the gap between academics and statistical agencies has allowed this development to proceed." p19
- From industry to aggregate productivity growth bottom-up or top-down. SC bottom-up approach. { I agree with this but then I also believe that the devil is in the detail}.
- Wulong is aware, as all users should be, of the rather strong assumptions made underlying the current statistics.

Denny's Thoughts

- "Real value-added is a measure of primary input use" p.3
- "The major point is that value-added in current or constant dollars is a measure of resource use and not output." SC's Anna Ansmit accepted this view and claimed that SC was not responsible for users' misinterpretation in believing real value-added to be a measure of output. p.23
- "If we wish to study the behavior of producers as market conditions change due to changes in private or public behavior then measures of gross output are required." p.3
- "Disaggregated industrial statistics and productivity studies have erroneously been based on real value-added and we want to explore what errors this involves." p.4
- "It would be erroneous to believe that any concept of real value-added can in fact accurately reflect the output or contribution to output of particular industries." p.6
- It is probably beneficial to consider the gross output of establishments and an industry as including own-output consumption since to net it out assumes efficiency. "if we are finally aggregating industry outputs to link with final demand expenditure aggregates then all outputs that do not flow to these users are eliminated." Appendix E p.48

More Thoughts from Michael

- "Establishment surveys cannot adequately measure he components of payments to capital." p. 23
- All rents from fixed assets are recorded as income and assets of the **owning** industry not the using industry. Consider retail trade and office space and the real estate industry or leasing of equipment/storage space (the cloud).
- "regrettable failure of Statistics Canada to maintain an adequate level of documentation." Still happening?? p. 23
- "All productivity measurements involve the use of implicit or explicit production functions." p. 28
- Clear need to account for quality changes in inputs and outputs. p.30
- If real value-added is used as a measure of output then factor augmenting technical change is due to capital and labour is equal and "materials augmentation is assumed to equal zero". p. 31.

A Concern I Have

 Table 3: Industry contribution "The high MFP in those industries agriculture, manufacturing, distributive trade and transportation) is a result of innovation and technical progress in those industries." p 12 of Wulong's paper but based on real value-added AND we are told on page 7 of the same paper that following the Jorgenson et al, 2005 that"For MFP growth based on value-added to measure technical progress, an industry must have gross output production that is separable in value-added.." Does this condition hold throughout all of these industries?

Rates of Return

- Answer "endogenous" if not "not extreme". Suggestion: When running regressions throw away the outliers to improve your results.
- Denny and May aware of this issue and investigated using different approaches although adopted exogenous approach as did Mel Fuss.
- Robert Oster and Dale Jorgenson had worked on this issue in 1967. Abandoned in 1971 because of conceptual inconsistencies between financial theory and investment (Fixed assets).
- Note underlying assumption of constant returns to scale which Denny and May have tested and rejected for Cdn Manufacturing.

3.1 Extensions: Intangible Capital

- Software and computerized database, innovative property (R&D) and economic competencies (brand equity, training, and organizational capital. SC: R&D, exploration and software only. Result: inclusion reduces increases MFP decline in Cdn business sector in 2000-2008 period by .2 percentage points (-0.8% from -0.6% p.a.) What's the story?
- Denny calls for investigation by SC into the capitalization of R&D, advertising, education and health expenditures.

3.2 Natural Capital: Oil and Gas and Mining

- MFP declining and due to unmeasured R, natural resource capital.
 - Ignores differences in quality of R and unwanted inputs/outputs and existence of deleterious materials such as silica in iron ore which must be removed. Incidentally, Denny and I did work in this area in the late 70's and early 80's using individual iron ore mine data supported by Dep't of Mines and Energy. Also interesting work by Larry Lau and Dale Jorgenson also on iron ore mining proceeded our efforts.
 - Note r is set exogenously meaning that p_k is also determined exogenously but ignores differences in risk and the NPV analytical model which the industry uses. The "hurdle" rate of return on the east coast is 15% real after corporate taxes and royalties using f.o.b. well-head prices for the resource.
 - Assuming that resource rents per dollar value of resource is equalized across different types of resource assets is adopting a computational methodology of convenience assuming very strong theoretical assumptions.
 - Relationship between natural resources prices and MFP has an element of truth but somewhat more complex when one considers rapid technological advances and also often lengthy time dimensions bringing discoveries into production.

3.3 Incorporation of Public Infrastructure Capital (PIK)

- Note underlying assumptions of constant returns to scale and factors being paid their marginal revenue product.
- PIK: no impact on marginal rate of substitution in private sector between K & L. Is this true?
- Competitive market for provision of PIK. Really?

3.4 Capacity Utilization

- Jorgenson had taken capacity utilization into account as far back as the late 1960s using variations in electricity consumption?
- Why not use Capital and Repair Expenditures Survey?
- Denny: "SC could locate some three digit industries in which measures of capital utilization could be approximated."

Use of Final Demand Products (Q_F)

- Several reasons for this basis for measuring MFP rather than by industry. Good idea!
- "Deliveries to final demand QF are of interest because economic welfare has been defined in terms of output that flows to current consumption or enhances future consumption" Denny p.4
- "More detailed information on QF (final demand output) at the industry level would be very interesting would be very interesting since QF is the variable that corresponds directly to the demand items included in GNE." Denny p 5.
- Issue of division of final output into consumption and investment. "The largest areas of concern are expenditures by households on job-related activities." Denny p. 8

Including Education and Health Care Sectors in MFP Measurement

- Important area but more work has to be done on output measurement.
- Denny p. 41 The utility function, U(X) has X as a vector of outputs or commodities. "The description of the commodity should be the same for the output of the production sector and the arguments of the utility function."
- Denny p. 42 "Changes in the Becker-Lancaster consumers' technology are equivalent to changes in the utility function."
- Wider problem Denny states of gathering data on non-market behavior.
- Real problems when there are no market boundaries or no physical objects.
- Need to measure characteristics.
- For non-commercial industries need to slice the continuum from input usage to ultimate satisfaction at some point.
- Currently number of episodes of treatments weighted by costs of treatments. Is this the point at which transactions are made?

Households: Intermediate Goods and Final Goods

- Denny p. 10 "The great stumbling block is the failure of households to keep records in the sense that businesses keep records."
- "A substantial fraction of the asset price for a commodity is a payment for the transaction services involved. That portion of the price should not be capitalized." Denny p.11

Government Intermediate Products

- Denny example of road usage in Appendix D (p. 44): "The contribution of the free service input to business output will be reflected in the market value of the goods. This implies that if market valuations are to be used, the market value of the government services" should be valued at their cost or we should "increase the prices of the goods into which the free intermediate services enter as inputs."
- In this case intermediate inputs in the national accounts enters as final products.
- Note that some road usage includes final products (household travel to cottages) and some as intermediate goods (travel to work).

Conclusions

- SC caught in a bind as business and policy-makers extol the need for, and the social benefits of productivity gains.
- Other statistics agencies and organizations such as the OECD introduce new data extensions and put pressure on SC.
- While academics such as Dennison, Griliches, Jorgenson and Diewert have led the way coupled with less acknowledged contributions from Hulten. Canadians such as Fuss and Denny academics have played a vital role but doees not seem to be acknowledged by Tunney's Pasture.
- Chad Syverson (JEL 2011) has a good summary of recent contributions of what determines productivity starting at the firm level.
- Denny's concluding sentence in the paper is: "It should be emphasized that the strong points of current S.C. practices have often been ignored since there are many interesting and complex problems remaining." p. 37
- Need to liberate and extend access to more micro data in Canada. There are lots of
 extremely interesting problems to be tackled. Certainly, Michael Denny believed so as he
 made preparations to teach a new course in Productivity and Growth Theory.
 Unfortunately, for potential students this course was never delivered.

Thanks

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Doug and Michael, November 2013

