Use and Abuse of the Solow Residual

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Date : Aug 2, 2019

Robert Solow's neoclassical growth theory, to his surprise, provided the framework that rigorous general-market-equilibrium modeling has long used to explain trend and cyclical economic performance. This post, the fourth in a 5-part summary of the GEM Project's contribution to growth theory, focuses on a mainstay of that analysis: the Solow residual (SR), by far the most famous macro estimation residual. Getting ahead of the story, here's what has always troubled me. I find it difficult to believe that the original SR misuse by Real Business Cycle (RBC) theorists wasn't a deliberate attempt to deceive the rest of us. It looks and smells like a Ptolemaic effort to provide (false) predictive content to a model class that inherently lacks actual stabilization relevance.

Solow's aggregate production function, in its Cobb-Douglas simplification with a Hicks-neutral productivity term, is: $X(t)=A(t)H(t)^b K(t)^{1-b}$ such that X denotes total output, H is total hours, K is capital, and A represents multifactor productivity. Once rearranged to feature output per labor hour, it became the key formula in the large literature on growth accounting: $x(t)-h(t) \cong ((1-b)/b)(k(t)-x(t))+(1/b)a(t)$, where lower-case variables denote rates of change. In empirical exercises, the estimation error (the Solow residual) is widely assumed to measure effects of technological change.

Use of the residual. Fitting the highly simplified model to U.S. data since 1874 suggests that the trend improvement of multifactor productivity accounts for roughly half of the overall gain in living-standards. Attributing the remainder of that gain largely to technological change is widely accepted as plausible. (See Chapter 1 of the website's e-book.) But technology is clearly not the whole story. In an example from the previous three posts, parsing out the Solow residual to its likely causes must include Lewis transfer, i.e. nonstationary output-per-hour gains resulting from the movement of labor from low- to high-productivity jobs. Labor transfer exerted a substantial influence on U.S. productivity advance in the early-phase of the Second Industrial Revolution.

As described two weeks ago, the GEM Project has expanded Lewis transfer in post-turning-point economies to include two-way labor flows between high- and low-productivity venues, with unemployment providing a buffer. An example of rational reverse flow is the significant 1980s U.S. corporate downsizing associated with the sharply increased labor costs experienced in large establishments during stagflation decade. (See Chapter 4.) Growth-accounting results are consistent with the relative contraction of high-productivity employment; from 1979 to 1990, output-per-hour growth decelerated to 1.6% annually (well below the 2.5% average between 1948-98), with almost all the decrease attributable to the slowdown in multifactor-productivity (0.5% compared to its 50-year average of 1.4%). Mainstream market-centric analysis of the downsizing period has concentrated on identifying examples technological regress occurring in the 1980s.

Abuse of the residual. Another SR artifact of market-centric general-equilibrium analysis, this time concerning instability, was originally championed by RBC theorists. They used the capacity of the Solow residual to closely track stationary as well as nonstationary behavior of labor productivity to support their argument that business cycles are caused by technology shocks. If valid, that interpretation reestablishes the classical dichotomy and fatally discredits of the discretionary management of aggregate nominal demand. Fortunately for plausible policymaking, the generalized-exchange version of Solow's growth model, outlined in last week's blog and more fulsomely in the e-book's chapter 3, provides a much different explanation for the cyclical behavior of the Solow's residual. As shown last week, the Project's generalization of exchange incorporates meaningful wage rigidity (MWR) and its rational suppression of wage recontracting into Solow's neoclassical growth. The enriched model uses the interaction of continuous-equilibrium MWR with nominal-demand fluctuations to generate business cycles that are much more consistent with the available evidence than those produced by fanciful technological regress.

Most responsible for the abuse of the Solow residual is Finn Kydland and Edward Prescott's 1982 article ("Time to Build and Aggregate Fluctuations") that introduced their prototype RBC model. In it, they assert that the cyclical behavior of the Solow residual ratifies the practical use of the real-business-cycle approach. In their thinking, technological advance and regress dominate macro cyclicality, eliminating the need for money in the explanation of instability and for discretionary action in the amelioration of recessions. Their misuse of the Solow residual is egregious. Simply because an estimation residual was named technological change does not

mean it adequately represents technological change, especially when it occurs at business-cycle frequencies. K&P assert RBC policy relevance wholly on the unsupported assumption of outsized technological regress that nobody has ever experienced.

More serious analysis tells a much different story. In the fully microfounded generalized-exchange model class, SR fluctuations reflect (as noted above) the cyclical adjustments that result from the interaction of rational MWR and nominal demand disturbances, making Solow growth consistent with Early Keynesian thinking. Cyclical contractions in employment, output, and income represent continuous-equilibrium large-scale market failure that is best understood as a macro externality that mandates active demand-management by stabilization authorities. That recognizable world is far removed from K&P unrecognizable, albeit neoclassically convenient, macrodynamics.

My main complaint will now be reiterated. You have to be pretty unaware to believe that the cyclical behavior of the Solow residual since the advent of the Second Industrial Revolution is not substantially influenced by the interaction of nominal demand disturbances and meaningful wage rigidity. Were K&P debilitatingly naïve or did they deliberately mislead, especially as they reached for policy relevancy? If so, they powerfully illustrates the general house-of-cards problem with RBC analysis. Perhaps the biggest nail in the coffin is the GEM Project's demonstration that the RBC claim to optimizing microfoundations is incorrect. That flawed model is constructed on the critical assumption that all rational price-mediated exchange occurs in the marketplace. Perhaps K&P did not understand that market-centricity has long been the most arbitrary, indefensible assumption in common use in macro model-building, especially in the age of information-challenged workplaces. But ignorance does not alter the illegitimacy of the K&P claim to micro-macro coherence. Nor does it justify their cynical misuse of the Solow Residual.

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