

Medium Term Business Cycles in Developing Countries

Diego Comin, Norman Loayza, Farooq Pasha and Luis Serven

Online Appendix

I. Calibration (Not for publication)

In this appendix we describe the calibration of the eleven standard parameters and the six parameters that relate to the R&D process. We set the discount factor β equal to 0.95, to match an investment to output ratio of 0.22. Based on steady state evidence we also choose the following numbers: (the capital share) $\alpha = 0.33$; (the depreciation rate) $\delta = 0.1$; and (the steady state utilization rate) $U = 0.8$, based on the average capacity utilization level in the postwar period as measured by the Board of Governors. We set ζ to 0.5 which yields a Frisch elasticity of labor supply of 2. This value is in line with the values used in calibrations (e.g., Cooley (1995) and yields a level of hours worked in Mexico of 0.4. We set the elasticity of the change in the depreciation rate with respect to the utilization rate, $(\delta''/\delta')U$, at 0.15, used, for example, in Jaimovich and Rebelo (2009) and Comin, Gertler and Santacreu (2009). Finally, based on evidence in Basu and Fernald (1997), we fix the steady state gross value added markup in the consumption goods sector, μ_c , equal to 1.1 and the corresponding markup for the capital goods sector, μ_k , at 1.15. We normalize the number of final goods firms to 1. Given this normalization and the markups, we set the operating costs parameters, b_c and b_c^k , so that the total overhead costs from entering are 10% of gross output. This implies that $b_c = 0.5$ and $b_c^k = 0.016$.

We set the population of the U.S. relative to Mexico to 3. Similarly, we set the relative productivity levels in final goods production to 3.35 so that U.S. GDP is approximately 12 times Mexico's GDP.

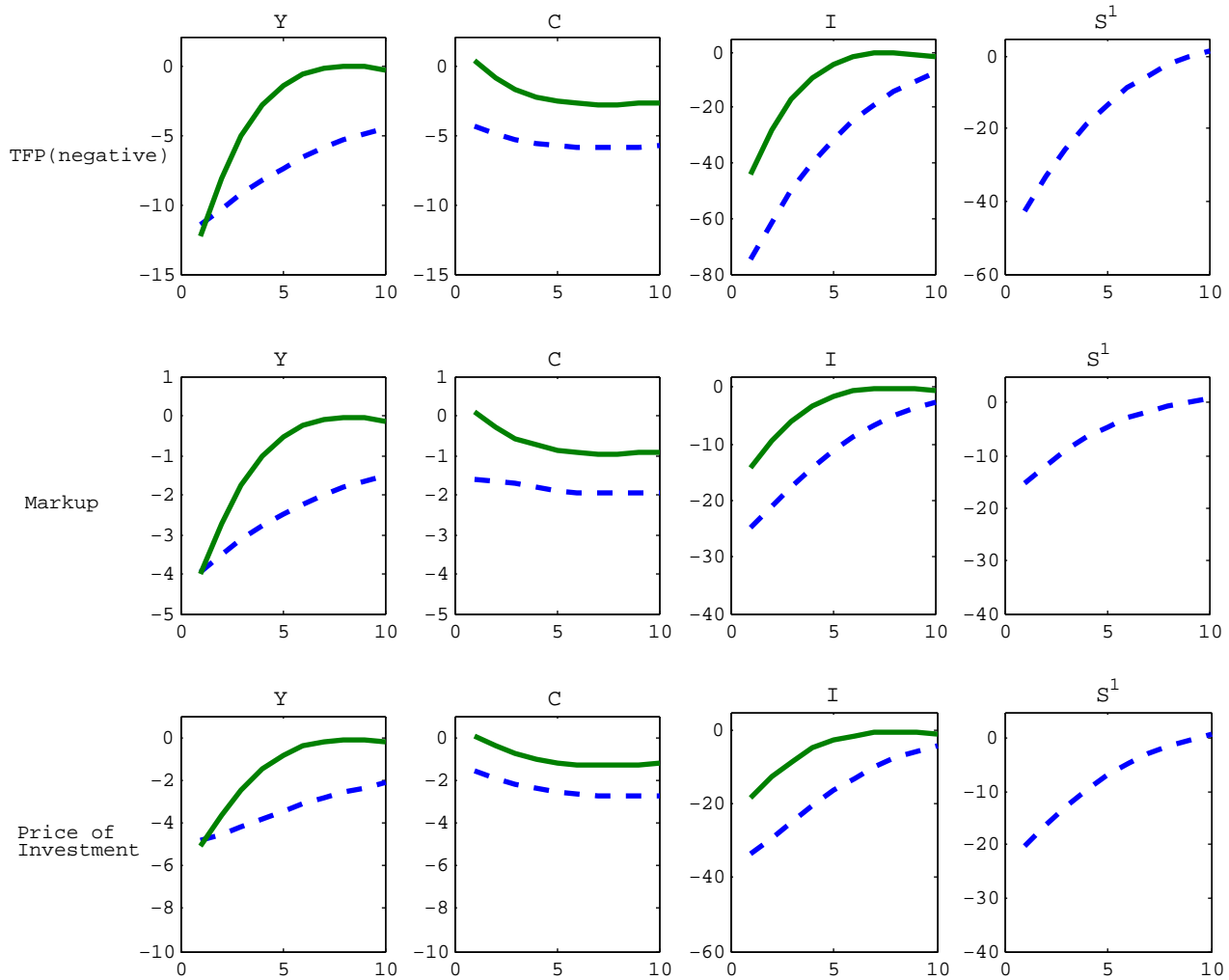
We next turn to the “non-standard” parameters. The estimates for the obsolescence rate have a range from the 4% per year in Caballero and Jaffe (1992) to around 25% in Pakes and Schankerman (1984). Based on this range we consider an obsolescence rate of 10% which implies a value for ϕ of 0.9. The steady state growth rates of GDP and the relative price of capital in the model are functions of the growth rate of new technologies, which in our model are used to produce new capital, and of the exogenous growth rate of disembodied productivity, g . By using the balanced growth restrictions and matching the average growth rate of non-farm business output per working age person (0.024) and the average growth rate of the Gordon quality adjusted price of capital relative to the BEA price of consumption goods and services (-0.026), we can identify the growth rate of disembodied productivity, g , and the productivity parameters in the technologies for creating new intermediate goods, χ . Accordingly, we set $g = 0.0072$ and $\chi = 2.69$.

There is no direct evidence on the gross markup θ for specialized intermediate goods. Given the specialized nature of these products, it seems that an appropriate number would be at the high range of the estimates of markups in the literature for other types of goods. Accordingly we choose a value of 1.5, but emphasize that our results are robust to reasonable variations around this number.

There is also no simple way to identify the elasticity of new intermediate goods with respect to R&D, ρ . Griliches (1990) presents some estimates using the number of new patents as a proxy for technological change. The estimates are noisy and range from about 0.6 to 1.0, depending on the use of panel versus cross-sectional data. We opt for a conservative value of 0.65, in the lower range. The calibrations of θ , ϕ , χ and ρ yield an R&D share in U.S. GDP of approximately 1% which is in line with the ratio of private R&D expenditures in the investment goods sector to GDP, averaged over the period 1960-2006.

Finally, we fix the autocorrelation of the TFP shock to 0.8 which is lower than the values used in RBC models due to the fact that our model generates some endogenous persistence of TFP. We set the autocorrelation of wage markups to 0.6 to match the persistence of the wage markup in Gali, Gertler and Lopez Salido (2002). Similarly, we set the autocorrelation of the price of investment shocks to 0.64 to match the estimates in Greenwood, Hercowitz and Krusell (2000).

Figure A1: Impulse Response Functions for U.S. TFP, Wage Markup and Price of Investment Shocks Model Without International Technology Diffusion (U.S. dash, Mexico, solid)



¹ Research and development expenditures (S, --)