APPENDIX†

US Fiscal Policy Shocks: SVAR Overidentification with External Instruments

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April 2022

†This appendix is not intended for publication.

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A.1 Additional Figures

Figure A1 shows the estimated shocks $\{\hat{\epsilon}_{g,t}, \hat{\epsilon}_{\tau,t}, \hat{\epsilon}_{y,t}\}$ from the just-identified case (in black) and the overidentified case (in red). The shocks are very similar from the two identifications.

Figure A2 shows the 3x3 matrix of IRFs. Panel A shows the estimated effects of ϵ_g, panel B shows the effects of ϵ_τ, and panel C shows the efects of ϵ_y. The just-identified case is shown in black while the overidentified case is shown in red. Dashed lines show 68% asymptotic confidence intervals which are calculated using the delta method. There is more precision particularly in the effect of ϵ_g on τ and on y (as noted in the text) in panel A and the effect of ϵ_y on τ in panel C. In these cases the confidence intervals are much narrower in the overidentified case.

A.2 Alternate Shock Measurements

We calculate the three structural shocks by inverting $\hat{\Theta}$, as shown in equation (4). One concern with this approach is that it may be sensitive to violations of the estimation assumptions because identification of the three shocks is no longer independent, even for IV estimation. This is because in general the inverse of a matrix depends on all elements of the matrix. If the exclusion restrictions were not satisfied for one of the instruments, then the associated column of $\hat{\Theta}$ would not be correct. These errors could affect all elements of the inverse of $\hat{\Theta}$, and by extension all of the shocks, even if the assumptions for the other two instruments are satisfied. If the shocks were instead uncovered individually then violations of the identifying assumptions for one shock should not influence the other shocks, which may result in lower correlations for at least some of the shocks. Stock and Watson (2018), who study the case when only one column of Θ is identified, show that the respective shock—the government spending shock, for example—can be uncovered as:

$$\hat{\epsilon}_{g,t} = \frac{\hat{\Theta}_g' \hat{\Sigma}^{-1}}{(\hat{\Theta}_g' \hat{\Sigma}^{-1} \hat{\Theta}_g)} \hat{u}_t, \tag{A1}$$

where Θ_g is the column of Θ associated with government spending shocks, which is the first column in our application. Since equation (A1) depends only on a single column of Θ, these shocks may be less susceptible to violations of the exclusion restrictions. The correlations of the shocks identified in this way are: $\rho(\hat{\epsilon}_{g,t}, \hat{\epsilon}_{\tau,t}) = -0.17$, $\rho(\hat{\epsilon}_{g_t}, \hat{\epsilon}_{y,t}) = 0.14$, $\rho(\hat{\epsilon}_{\tau,t}, \hat{\epsilon}_{y,t}) = -0.04$. The estimated correlations do depend on the way in which the shocks are calculated. Notice, though, that all correlations are larger in absolute value when calculated with the Stock and Watson (2018) method, indicating that our finding of sizable, sample correlations between the structural shocks is not sensitive to the method of calculation.

Notes to Figures

Figure A1: Estimated Structural Shocks

Notes: The figure shows the estimated structural shocks $\{\hat{\epsilon}_{g,t}, \hat{\epsilon}_{\tau,t}, \hat{\epsilon}_{y,t}\}$ from the just-identified case (in black) and the overidentified case (in red) for the period 1951–2019. NBER recession periods are shown in grey.

Figure A.2: Impulse Response Functions

Notes: Panel A shows the effect of $\hat{\epsilon}_g$, panel B shows the effects of $\hat{\epsilon}_\tau$, and panel C shows the effects of $\hat{\epsilon}_y$. The just-identified case is in black while the overidentified case is in red. Dashed lines show 68% asymptotic confidence intervals.

Figure A1: Estimated Structural Shocks

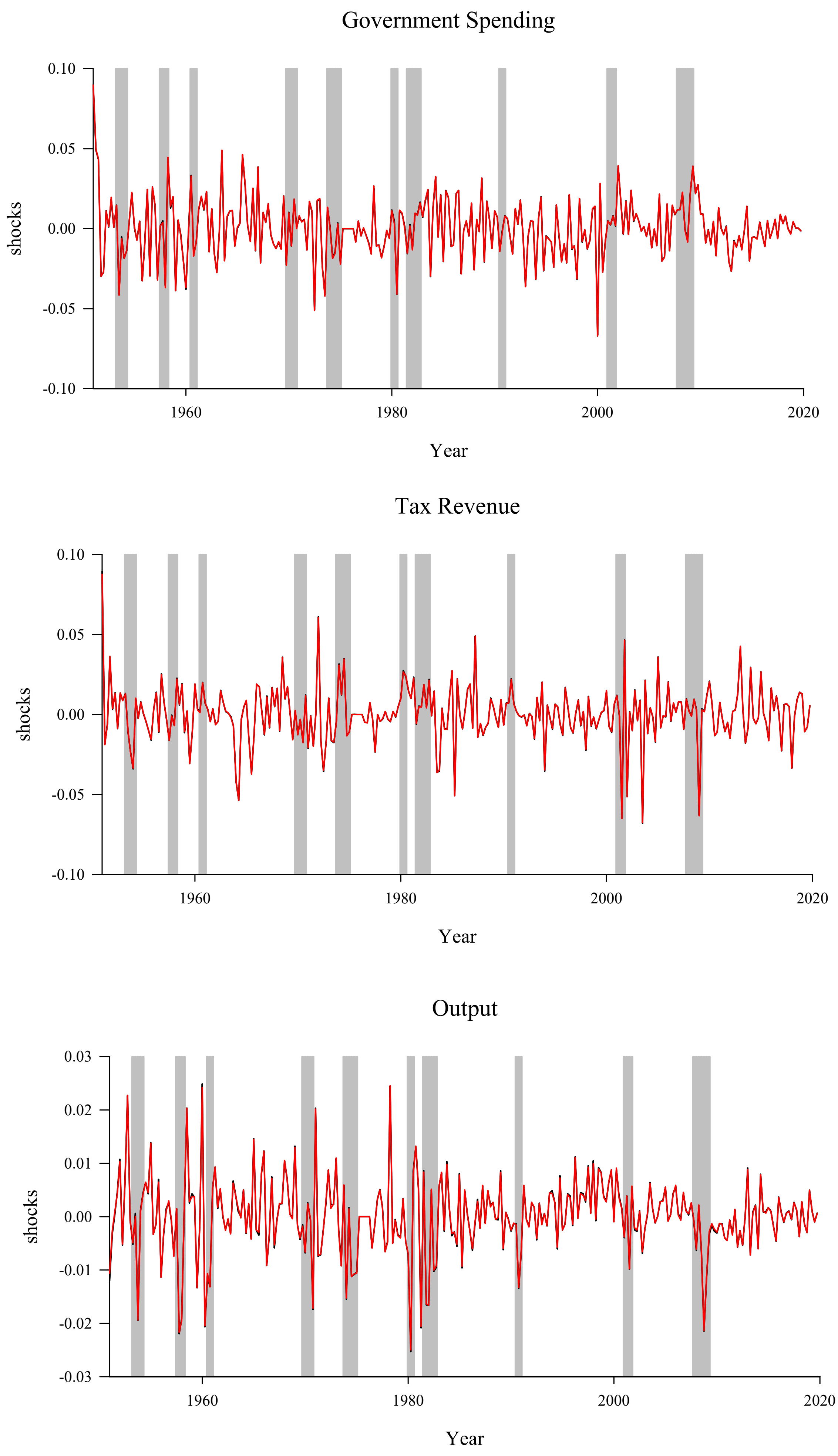

Figure A2A: Impulse Response Functions
Government Spending Shock

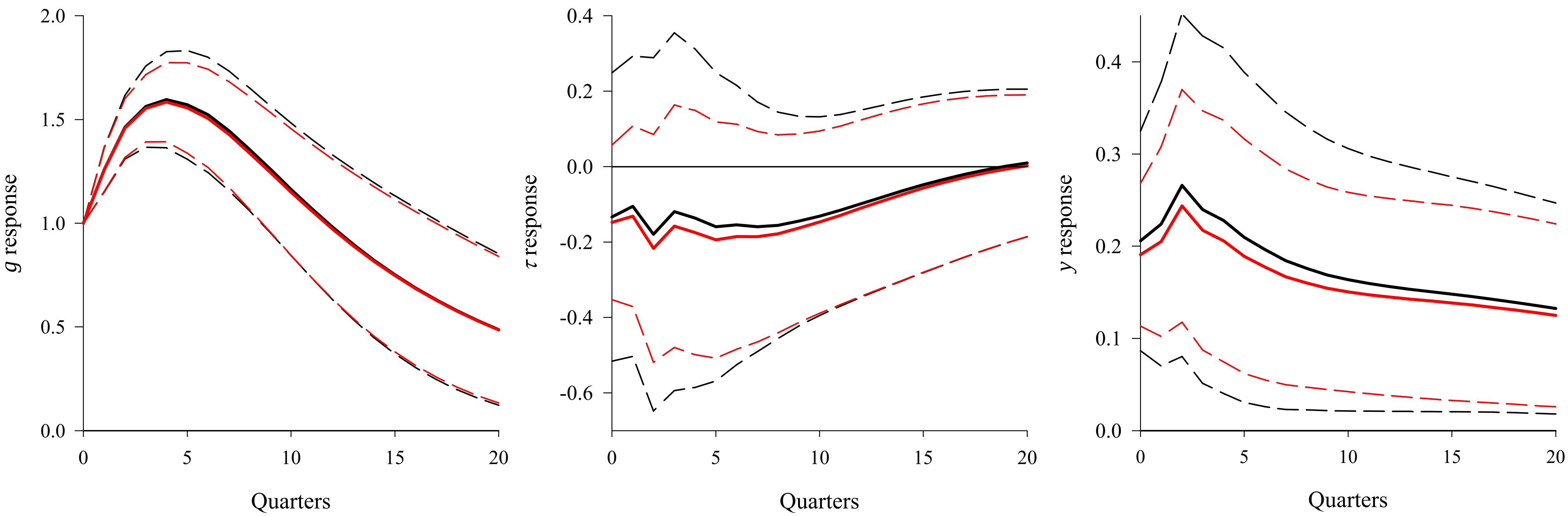

Figure A2B: Impulse Response Functions
Tax Shock

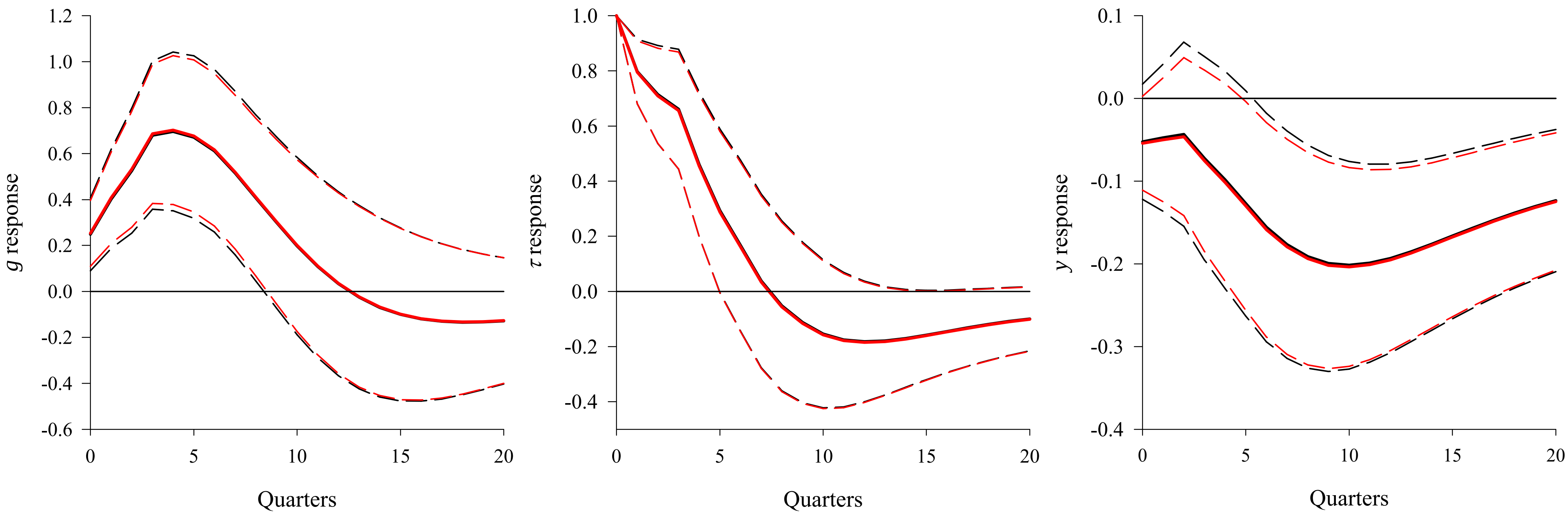

Figure A2C: Impulse Response Functions
Output Shock