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REVIEW ARTICLE

Hours Worked and Permanent Technology Shocks in Open Economies

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Over the last decade, a question has attracted a great deal of attention: *How do hours worked respond to a positive permanent technology shock?* Relying on Structural Vector AutoRegressive (SVAR) techniques and identifying the permanent technology shock as the only shock affecting productivity in the long-run—which amounts to use the Blanchard and Quah [1989] identification scheme—Galí [1999] found that hours worked show a permanent decline in the aftermaths of a positive permanent technology shock. Galí [2003], Galí and Rabanal [2004], Basu et al., [1998] found similar results and conclude that the empirical correlation between hours worked and productivity—as well as that between employment and output—*conditional* on technology shocks is negative. This result raised some important theoretical concerns regarding the empirical validity of Real Business Cycle (RBC) models. Indeed, the flexible prices RBC model assigns a critical role to technology shocks as the driving force behind macroeconomic fluctuations. Since these models are mainly driven by intertemporal substitution motives, any technology shock, by raising the marginal product of labor, translates into an increase in the real wage and therefore into an increase in the labor supply. In other words, technology shocks lead to procyclical movements in hours worked. The preceding findings comes in clear contrast with the main predictions of the model and raises "*... serious doubts not only about the relevance of the RBC model but more importantly about the quantitative significance of technology shocks as a source of aggregate fluctuations in industrialized economies...*" (Galí, 2003). On the contrary, Galí [1999] showed that a sticky price model, in which output is demand driven, can account for this fact.

Three main lines of defence have been adopted to face this finding. A first one has been to show that, once properly modified, the canonical flexible price model can actually account for a decline in hours worked following a positive permanent

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technology shock. For instance, it is easy to show that once the close economy flexible price model is augmented by mechanisms that prevent both consumption and investment from responding too much to a technology shock (habit persistence, adjustment costs ...), hours worked can drop in face a technology shock (see Francis and Ramey [2001]). Indeed, since the increase in productivity is not accompanied by an increase in the demand side of the model, then hours worked have to decrease in order for the good market to clear. Likewise, any mechanism that leads to a significant decrease in the labor supply in the aftermaths of a positive technology shock can yield the negative response of hours worked. This can be obtained through strong wealth effects that favour leisure or intertemporal substitution motives that favor future rather than current work effort. Recently Collard and Dellas [2007] argue that the open economy dimension can enhance the flexible price model's ability to account for Galí's stylized facts. They show that a positive domestic supply shock may lead to a decline in hours worked if domestic and foreign goods are not good substitutes. The idea is that the domestic terms of trade must worsen significantly in order to clear the market when goods are poor substitutes. This reduction in the relative price of the domestic good discourages output expansion, which in turn translates into lower hours worked. A second line of defence has been to argue that sticky price models perform as poorly as flexible price models in accounting for this fact. For instance, Dotsey [1999] shows that the new-Keynesian model leads to a positive conditional correlation between output and hours worked in the aftermaths of a technology shock provided monetary policy is sufficiently procyclical. A last line of defence has been to argue that SVARs do not properly identify technology shocks (see Chari et al [2008]). In other words, hours worked may well decline in the aftermaths of a shock, but we cannot be sure that this is indeed a technology shock (not even a structural shock).[1]

This paper clearly belongs to the latest category. It argues that the very existence of an international transmission of shocks prevents the SVAR to correctly identify permanent technology shocks. More precisely, they show that the sign of the response of hours worked to a permanent technology shock, as identified using long—run restrictions, depends on the level of cross-country aggregation which is used to build the measure of productivity. Using Annual G7 data for the period 1972–2004 they show that the response of hours worked is indeed negative when the SVAR procedure is applied to each individual country. The result does not survive when aggregate data for the G7 are used. These results are mutually inconsistent as productivity levels are found to cointegrate within the G7. This inconsistency that they label an aggregation puzzle casts doubts on the ability of the SVAR model to accurately identify the technology shock.

There are at least two ways of interpreting Dupaigne and Fève's result

1. Aggregate international data do contain specific information about the international transmission of productivity shocks that an individual country approach ignore.

[1] Note however that Francis and Ramey (2001) examine whether technology shocks as identified by the Blanchard and Quah [1989] identification scheme behave like true technology shocks and conclude that this seems to be indeed the case.

2. The use of international data enhances the ability of the VAR to properly identify technology shocks.

The first point teaches us that by using international data Dupaigne and Fève are able to exploit the information contained in the international transmission of shocks to better(?) identify the effects of permanent technology shocks on hours worked. Otherwise stated, by running a VAR on individual country data the econometrician would simply ignore the fact that technology shocks are transmitted internationally and will not be able to take advantage of this identification device when studying the response of hours worked to a shock. For instance, let us consider a two country model in which both economies are hit by both permanent technology shocks and transitory preference shocks. Let us assume that the permanent shock is common to both economies (this insures the existence of a cointegration relationship) and that both transitory shocks are very persistent and uncorrelated. Let us also further assume that the transitory shock in the foreign country is much more volatile than in the domestic country. What standard international real business cycle theory teaches us is that in face of purely asymmetric shocks international transmission is very likely to be negative. In other words, a positive foreign transitory shock leads to a decrease in hours worked in the domestic economy. Then by not taking into account the information pertaining to the international transmission of shocks one may misinterpret the IRFs. By making explicit use of aggregate international data, Fève and Dupaigne are able to circumvent the problem and therefore better interpret their results.

The second point pertains to standard identification problems in SVAR models. Since that the foreign transitory (non-technology) shock is *i)* more volatile than the domestic one and *ii)* very persistent, the technology shock, as identified by the use of Blanchard and Quah decomposition, will be contaminated by the foreign transitory non-technological shock. Fève and Dupaigne actually alleviate the problem by taking advantage of the cointegration relationship to identify the permanent technology shock. Does this make their procedure immune to identification problems? This is less sure. Indeed, if the transitory shocks are persistent and display enough correlation, the identified permanent technology shock ought to be contaminated by the persistent–transitory shocks in small sample. Fève and Guay propose a methodology that deals with this problem in a close economy framework. Mixing this approach and the approach developed in this paper would certainly make their procedure more immune to this type of problem.