Online Appendix to "Patent-Based News Shocks"

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A Data

This section describes the data used in our analysis in detail. In our benchmark analysis, we use quarterly aggregate data that span the period from 1961:Q1 to 2010:Q4. In addition to the patent-based index that is described in the main body of the paper, here we describe additional series used in our analysis:

- The output measure is the log of real output in the nonfarm business sector (BLS: PRS85006043). The series is recovered from the Bureau of Labor Statistics (BLS).
- The hours series is the log of the total hours worked in the same sector (BLS: PRS85006033). The series is recovered from the Bureau of Labor Statistics (BLS).
- The consumption measure is the log of real personal consumption expenditures on nondurables and services (Bureau of Economic Analysis (BEA) Table 1.1.3., sum of lines 5 and 6).
- The investment series is the sum of real gross private domestic investment (BEA Table 1.1.3., line 7) and personal consumption expenditures on durables (BEA Table 1.1.3., line 4).
- The stock price measure is the log of the Standard and Poor's 500 Composite Stock Price Index, recovered from Robert Shiller's website.

We transform all these series into per capita values by dividing them by the BLS series of the civilian noninstitutional population over 16 (LNU00000000Q).

- The TFP measure is the log of the utilization-adjusted measure provided by Fernald (2012).
- The inflation measure is the percentage change in the CPI for all urban consumers (CPIAUCSL, St. Louis FRED).
- The federal funds rate series is the effective federal funds rate from the Board of Governors (FEDFUNDS, St. Louis FRED).
- The consumer confidence measure is taken from the Michigan Survey of Consumers as in Barsky and Sims (2011). This series is available from 1961:Q1 and, therefore, dictates the beginning period of our sample.

Industry Analysis: The CRSP data used to connect *permno* numbers with industry codes was downloaded via Wharton Research Data Services (WRDS). Center for Research in Security Prices, CRSP 1925 US Stock Database, Wharton Research Data Services, http://www.whartonwrds.com/datasets/crsp/.

Credit Conditions Indicators: Finally, as one of the robustness checks of our results, we control for credit conditions by considering three indicators (GZ spread, EBP, and BAA-AAA credit spread). All three credit conditions measures were taken from an online American Economic Review database provided by Gilchrist and Zakrajšek (2012), namely the file entitled GZ_quarterly.csv. The start period is later than in the benchmark analysis due to data availability. In particular, the sample starts in 1973:Q3.

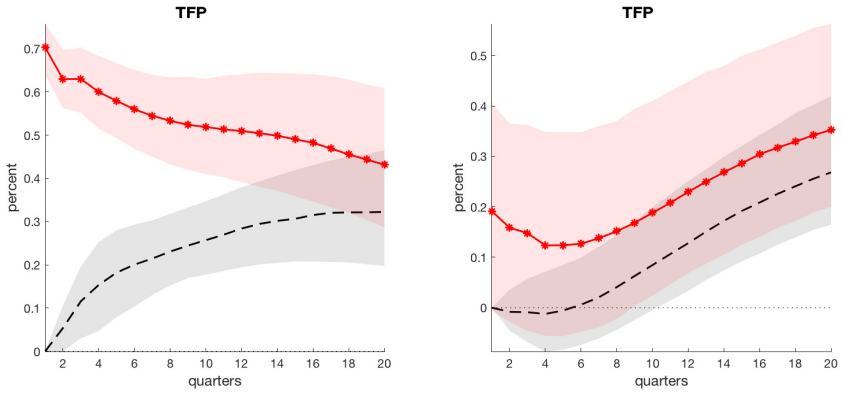
External Shocks: The economic shocks that we use to validate exogeneity assumption in the proxy VAR are downloaded from the Caldara and Kamps (2017) database. The measure for news about tax shocks is the proxy calculated by Leeper et al. (2013). News about government defense spending is calculated as the nominal present value of the Ramey (2011) defense news variable divided by the nominal GDP of the previous quarter, as calculated by Caldara and Kamps (2017). Oil price shocks are the net oil increase (three years) calculated by Caldara and Kamps (2017) based on Hamilton (2003).

Monetary policy shocks are the quarterly sum of the monthly Romer and Romer (2004) variable extended by Barakchian and Crowe (2013). Tax shocks are the Mertens and Ravn (2011) unanticipated tax series.

B Comparison of Patent-Based and TFP-Based Identifications

We briefly describe here how our (patent-based) identification scheme compares with the TFP-based identification schemes when it comes to the responses of the aggregate measure of productivity. In particular, we report the responses of TFP under two commonly-used identification schemes: the one proposed by Barsky and Sims (2011) and the one proposed by Francis et al. (2014). For both identifications, we impose zero restrictions on TFP's impact response as suggested originally in these identifications. In addition, we also relax this assumption in order to show how TFP would respond on impact when it is not restricted. The results are shown in Figure B.1.

Figure B.1 Responses of Utilization-Adjusted TFP to News Shocks



Note: The figure represents estimated impulse responses to a unit TFP-news shock identified using four different identification schemes. The left panel represents responses to a unit news shock identified using the Barsky and Sims (2011) procedure with (black dashed lines) and without zero impact restriction (red dash-starred lines). The right panel represents responses to a unit news shock identified using the Francis et al. (2014) procedure with (black dashed lines) and without zero impact restriction (red dash-starred lines). The time period is from 1961:Q1 to 2010:Q4, the system is estimated in levels of all variables (utilization-adjusted TFP, GDP, consumption, investment, hours, inflation, the federal funds rate, consumer confidence, and the stock price index) features four lags and a constant. The shaded areas around the responses represent +/- one standard deviation confidence bands obtained by drawing from the posterior.

Recall that in our identification scheme even though zero impact restriction is not imposed, the response of the TFP was not significantly different from zero. With TFP-based identification schemes, whether the zero restriction is imposed matters significantly, and in particular when the identification of Barsky and Sims (2011) is used. In particular, when the restriction is not imposed TFP responds significantly on impact, and falls over time, opposite to the response when the zero restriction is imposed. With Francis et al. (2014) identification scheme, TFP also responds on impact, although confidence bands are very wide, but it does not lose the original shape as in the case of Barsky and Sims' identification.

Overall, this comparison reveals that it is crucial in these identification schemes to impose the zero-impact restriction. In our case, however, we obtain this result without having to impose the restriction.

C Local Projections

In this part of the Appendix we report the results when we use local projections, as proposed by Jorda (2005). For each horizon h ahead, we estimate a different set of regressions as

$$\mathbf{y}_{t+h} = \alpha^h + \mathbf{B}_1^h \mathbf{y}_{t-1} + ... + \mathbf{B}_p^h \mathbf{y}_{t-p} + \mathbf{u}_{t+h}^h,$$

Where $\mathbf{y}_t$ is the same set of endogenous variables as in the baseline estimated for the impulse responses in the paper. The local projections are then calculated as

$$\hat{\mathbf{B}}_1^0 = \gamma_1$$

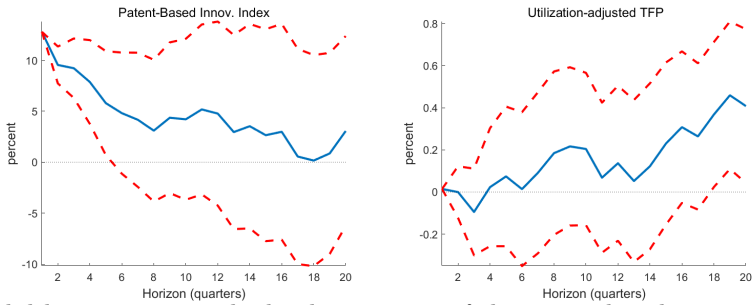
$$\mathbf{LP}(t, h, \gamma_1) = \hat{\mathbf{B}}_1^h \gamma_1,$$

And γ_1 is identified as a Cholesky recursive formulation, where the patent-based innovation index is ordered first.

Figure C.1 presents the local projections of a patent-based news shock on the the patent-based innovation index and on utilization-adjusted TFP. Figure C.2 presents the local projections on the addition variables in the information set. The projections recover

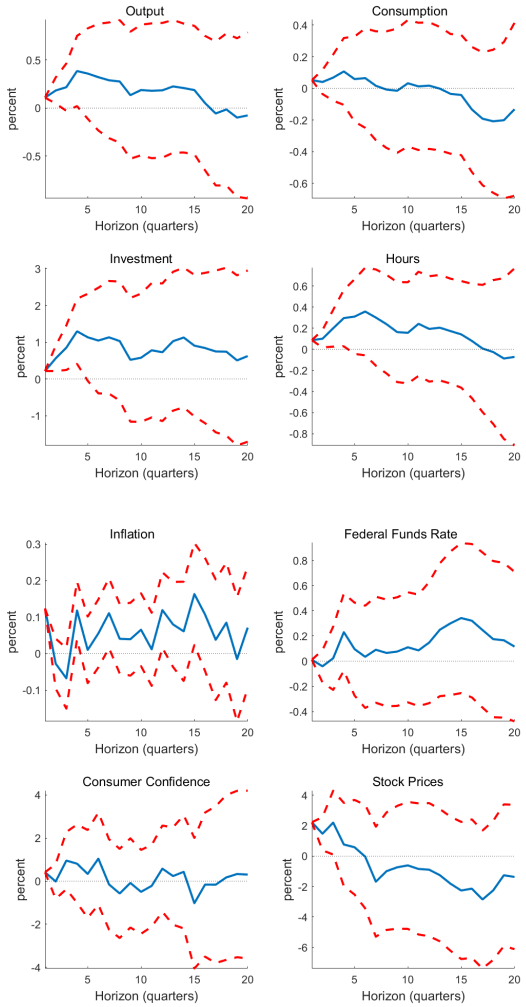
qualitatively the same path of the baseline impulse responses presented in the paper. We are also interested in the medium and long-run effects of the patent-based news shock, where confidence bands in local projections usually become quite wide.

Figure C.1 Local Projections of Patent-Based Innovation Index and TFP to a Patent-Based News Shock



Note: The solid line represents the local projection of the patent-based innovation index and utilization-adjusted TFP to a patent-based news shock. The time period is from 1961:Q1 - 2010:Q4. Dashed red lines represent +/- two standard deviations significance bands.

Figure C.2 Additional Local Projections to a Patent-Based News Shock

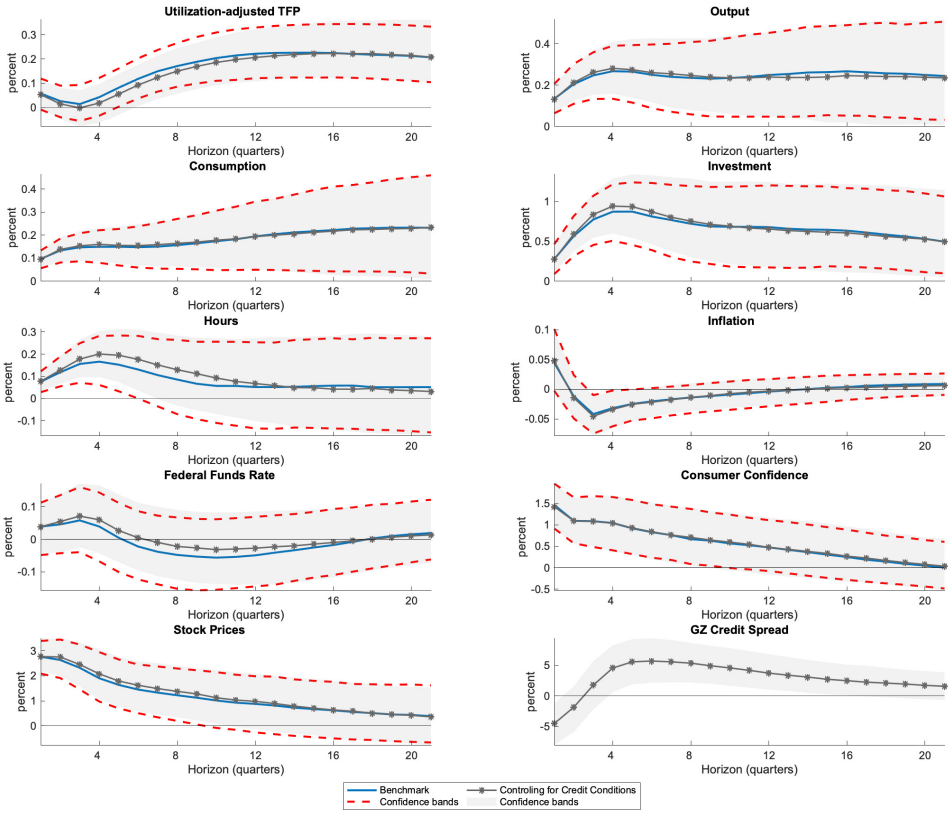


Note: The solid line represents the local projections to a patent-based news shock. The time period is from 1961:Q1 - 2010:Q4. Dashed red lines represent +/- two standard deviations significance bands.

D Additional credit conditions indicators

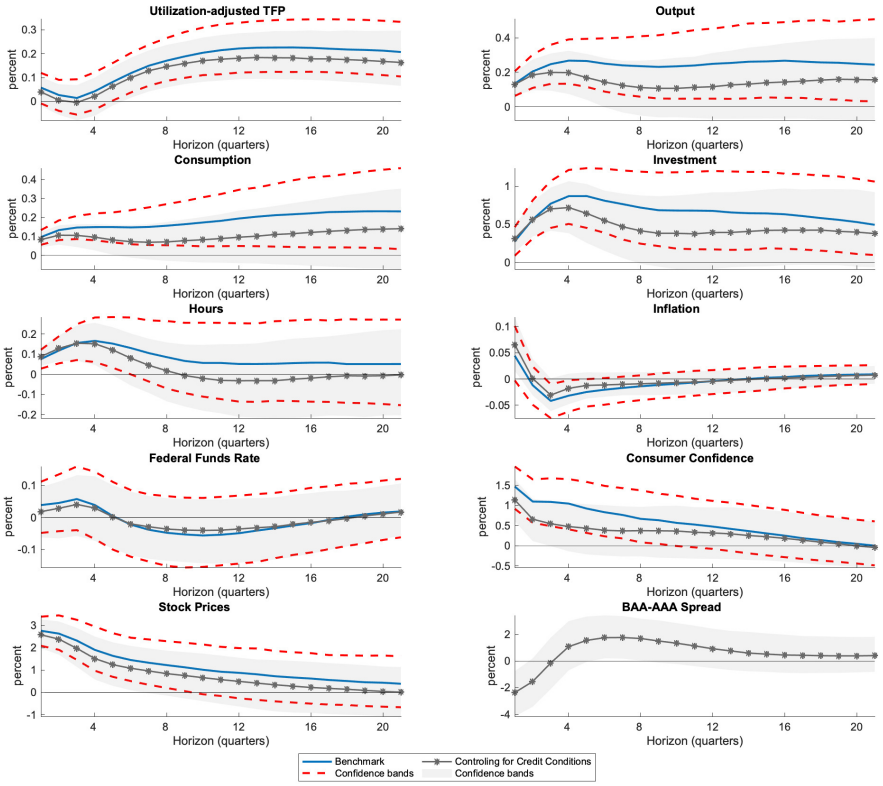
In addition to considering EBP in the paper, in this section, we control for credit conditions by including two more indicators: BAA-AAA spread and Gilchrist and Zakrajšek (2012) credit spread (GZ spread).

Figure D.1 IRFs when controlling for credit conditions using GZ spread



Note: Comparison of benchmark IRFs with the IRFs when credit conditions are controlled for by including Gilchrist and Zakrajsek's (2012) measure of credit spreads. Time period is from 1973:Q1 to 2010:Q4.

Figure D.2 IRFs when controlling for credit conditions using BAA-AAA spread



Note: Comparison of benchmark IRFs with the IRFs when credit conditions are controlled for by including BAA-AAA credit spread. Time period is from 1973:Q1 to 2010:Q4.

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