Online Appendix – Not For Publication

For "A Tale of Two Volatilities: Sectoral Uncertainty, Growth, and Asset Prices"

OA.1. Supplemental Sections

OA.1.1. Description of TFP Data From Fernald (2012)

This section describes briefly the consumption and investment TFP data obtained from Fernald (2012) and Basu et al. (2006) (for further details refer to these studies). Following Fernald (2012), the log-growth in aggregate TFP is defined as:

$$\Delta TFP_t = \Delta Y_t - \alpha_t \Delta K_t - (1 - \alpha_t)\Delta L_t$$

where ΔY is the log-growth in gross value-added, ΔK is the log-growth in perpetual inventory of capital stocks (calculated from disaggregated quarterly NIPA investment data), ΔL is the log growth of labor inputs (hours), and α is capital's share of output. Let $\Delta \tilde{P}_{i,t}$ be the log-growth in the *relative* price of investment (equipment):

$$\Delta \tilde{P}_{i,t} = log(P_i/P_c)_t - log(P_i/P_c)_{t-1},$$

where P_i is the price deflator of investment-goods, and P_c is the price deflator of non-equipment goods and services. Let $w_{i,t}$ be equipment share of business output. Then log growth of consumption TFP, ΔC-TFP, and log growth of investment TFP, ΔI-TFP, are computed by solving:

$$\Delta TFP_t = w_{i,t} \Delta\text{I-TFP}_t + (1 - w_{i,t})\Delta\text{C-TFP}_t$$
$$\Delta \tilde{P}_{i,t} = \Delta\text{C-TFP}_t - \Delta\text{I-TFP}_t.$$

The use of the relative price of investment goods to obtain investment TFP innovations is widely used in the macroeconomic literature, and was originally proposed by Greenwood et al. (1997). It can be shown that if producers in both sectors have equal factor shares of capital and labor, pay the same factor prices (i.e., wages and capital rents), and capital flows freely between the two-sectors intra-temporally, then changes in relative TFP of both sectors equal changes in the relative price of investment goods.

OA.1.2. Relation to Investment-Specific Technology

A growing literature in macro-finance emphasizes the role of investment-specific technology shocks (IST) for the business cycle and asset prices. This section explores the relationship between the sectoral volatilities and IST shock and its volatility.

IST innovations refer to the ratio between investment and consumption TFP's, or equivalently, the log-difference between the two. The most commonly used proxy in the macroeconomic literature for IST shocks is the negative of the relative price of investment goods. This proxy was first suggested by Greenwood et al. (1997), and widely used since. Greenwood et al. (1997) show that if the producers in both sectors have equal factor shares of capital and labor, pay the same factor prices (i.e., wages and capital rents), and capital flows freely between the two-sectors intra-temporally, then the relative price of investment goods equals the ratio between consumption and investment productivity shocks. The relative price of investment goods is measured as the ratio between the price deflator of (business) equipment to the price deflator of non-durables and services.

Several modifications to this baseline proxy were proposed in the literature. First, Basu et al. (2006) include the price deflator of durables as part of equipment goods (thus, treating durable goods as household-equipment). Second, Israelsen (2010) adjust the relative price of deflater of equipment for changes in the quality of investment goods (quality-adjusted price series for new equipment was first constructed by Gordon (2007) and extended by Cummins and Violante (2002) and Israelsen (2010)). The quality-adjusted relative price time-series is available only at the annual frequency. To obtain a quarterly time-series, I follow Garlappi and Song (2013a), and interpolate the annual quality-adjusted relative-price growth rate equally over four quarters.

Panel A of Table OA.1.1 shows the evidence from a projection of future cumulative quarterly IST-growth rate, measured via Basu et al. (2006) or Israelsen (2010) proxies, of horizon h quarters ahead, on the current proxies for sectoral first- and second- moment TFP shocks:

$$\frac{1}{h}\sum_{j=1}^{h}\Delta\text{IST}_{t+j} = \beta_{0,h} + \beta_h' X_t + error, \tag{A.6}$$

where $X_t = [\Delta\text{C-TFP}_t, \Delta\text{I-TFP}_t, \Delta\text{C-TFP-VOL}_t, \Delta\text{I-TFP-VOL}_t]$. The forecast horizon h varies between one to twenty quarters. Since the quarterly IST growth rate of Israelsen (2010) requires interpolation, Panel B shows the results when the dependent variable is replaced by the annual IST growth (without interpolation).

Panels A and B both show that consumption TFP first-moment innovation drops IST growth, while investment TFP innovation increases IST growth. This is consistent with the definition of IST as the ratio between investment TFP innovation to consumption TFP innovation. The Panels also show that consumption (investment) TFP-volatility increases (decreases) future IST growth. As IST is negatively related to the relative price of investment goods, this implies that consumption (investment) TFP-volatility should decrease (increase) this relative price. This prediction is empirically confirmed in Panel A of Table **3**. In the model section, Section 5.2, I demonstrate that the sectoral volatilities affect the the relative price of investment goods with opposite signs, which are consistent with this empirical evidence.

Importantly, in the benchmark analysis of this study I do not select IST and its volatility to be the economic fundamentals. Rather, I focus on the total TFP of the investment sector, and its volatility. This is because IST is a mixture between model primitives (a ratio between the productivity shock to the investment sector, and the productivity shock to the consumption sector). Consequently, the volatility of IST does not map to the volatility of the investment sector, but rather to an amalgamation of the sectoral volatilities. By contrast, the measures of total sectoral TFPs (and volatilities) map directly to the specification of the primitive shocks in my model.[1]

In spite of the fact that IST does not map to a specific/single fundamental in the model, the key empirical results hold when I replace investment TFP innovation by IST growth, and replace investment TFP-volatility by IST-volatility. This evidence of this robustness check is presented in Table OA.1.10, and discussed in Section OA.1.6. IST-volatility is constructed using the same methodology used to construct investment TFP-volatility, via equations (1) and (2). In particular, the evidence in Table OA.1.10 shows that a positive IST-volatility shock predicts economic growth positively, increases the market return, and has a positive market price of risk.[2]

To reconcile why the results still hold when IST-volatility is used, I examine the relationship between IST-volatility and the sectoral TFP-volatilities. In Table OA.1.2, I project contemporaneous IST-volatility on the sectoral first- and second- moment TFP shocks. I consider different proxies for IST-volatility, based on the IST first-moment proxies of Basu et al. (2006) and Israelsen (2010).[3] The evidence in Table OA.1.2 suggests that regardless of the proxy used, investment TFP-volatility relates positively to IST-volatility, while consumption TFP-volatility relates to it negatively. This is in-line with the positive impact of either IST-volatility or investment TFP-volatility on growth and prices.

Table OA.1.2 also shows how aggregate TFP-volatility, measured using equations (1) and (2) and data on aggregate TFP from Basu et al. (2006), relates to the sectoral TFP-volatilities. Controlling for both volatilities, consumption (investment) TFP-volatility correlates positively (negatively) with aggregate volatility. As aggregate volatility is countercyclical, this result highlights that investment TFP-volatility (or more precisely, its component that is orthogonal to the consumption sector's volatility), is procyclical, consistently with Figure OA.1.1, and the empirical evidence in Section 3.2.

OA.1.3. Sectoral Volatilities and Growth Implications: Event Study Approach

The opposite impact of the sectoral TFP-volatilities can also be manifested using an event-study methodology. I track key macroeconomic variables around events in which there is a switch from realized consumption TFP volatility dominated regime, to realized investment TFP volatility dominated regime, and vice versa. Specifically, for an event in which a switch happens from consumption- to investment- (investment- to consumption-) realized TFP volatility

[1] Another reason to refrain from focusing on IST in the empirical evidence is discussed in Basu et al. (2010). Basu et al. (2010) claim that the usage of IST shocks in existing studies is only one way to represent the data. An isomorphic productivity structure involves a neutral (common) productivity shock, along a *consumption* specific technology shock. As one can choose to normalize productivity either by the consumption TFP or by the investment TFP, I refrain from such normalizations. Instead, I consider in the data correlated TFP-volatilities for both sectors. This representation is not sensitive to one's decision of how to normalize the data. Importantly, the component of investment TFP-volatility that is orthogonal to consumption TFP-volatility is the key ingredient that generates the results, as discussion in Section OA.1.4.

[2] The evidence in Table OA.1.10 with respect to the beta and the market price of risk of first-moment IST innovations is ambiguous, and not statistically significant. This is consistent with the mixed evidence in existing literature. While Papanikolaou (2011) and Kogan and Papanikolaou (2013) find that investment-specific innovations are negatively priced, Garlappi and Song (2013a) and Li et al. (2013) both find that these shocks carry a positive market-price.

[3] For all IST first-moment proxies, the IST-volatility is constructed using the same methodology (i.e., equations (1) and (2)). The predictors used for computing ex-ante volatilities include consumption and investment TFP growth rates, consumption and investment TFP-volatilities, and the lagged realized variance of the volatility to be predicted (i.e., lagged realized IST volatility).

dominated regime, time zero is defined as the quarter in which the difference between investment and consumption realized TFP-volatilities turns positive (negative), while being negative (positive) in the last quarter. While these events are not exogenous, these turn points illustrate how macro dynamics alter from one regime to the next. I define the Cumulative Abnormal Growth of a macro variable y at time τ, CAG_τ, as the sum of the demeaned growth rates in y, $\Delta y_t - \overline{\Delta y_t}$, from five quarters before the event until quarter $\tau \in \{-5, .., 5\}$.

Figure OA.1.2 shows cumulative abnormal growth measures for consumption and GDP, around regime switching events. Panels (a) and (c) show that a switch from consumption to investment TFP-volatility regime is accompanied with a decline in the *CAG* of macro-variables prior to time zero (that is, while consumption TFP-volatility still dominates), and followed by an increase in the *CAG* after time zero (that is, when investment TFP-volatility begins to dominate). The exact opposite happens in Panels (b) and (d): a switch from investment to consumption TFP-volatility regime is characterized by a boost in the cumulative abnormal growth prior to the switch, and followed by a fall of this measure after the switch.

OA.1.4. The Role of Cross-Volatility Correlation: Empirical and Theoretical Assessment

A general concern regarding the empirical results presented in Section 3 can be that the results are spuriously driven by the high correlation between the volatilities, as reported in Table **1**. Specifically, the degree of correlation between the two volatilities raises a concern that there might be only one volatility process governing the conditional volatility of the TFP of both sectors. This section provides a discussion on this matter to alleviate this concern, as well as supporting empirical and model evidence.

It is worth noting that any multicollinearity between the two volatilities should not induce a signed bias into the empirical estimates of the projections in Section 3. In fact, multicollinearity makes it harder to obtain statistically significant loadings on the volatilities. In spite of that, in almost all Tables **2** - **7** the slope coefficient on the sectoral volatilities are separately (and jointly) significant at the 5% level.

Importantly, the empirical evidence in Tables **2** - **7** takes into account correlation structure. All projections are multivariate, and thus, incorporate the effect of any correlation between the volatilities. When obtaining the market prices of risk, the factor risk premia are orthogonalized using the variance-covariance matrix of the shocks. The impulse-response evidence in Figure **3** uses a Cholesky decomposition to orthogonalize the volatilities from one another (and from first-moment shocks).

Moreover, the correlation between the sectoral volatilities is not a robust feature of the data: it depends considerably on the implementation choices for volatility construction (e.g., which variables are used to predict future realized variances, over how many quarters are the realized variances measured, etc). By varying the benchmark implementation choices for volatility construction, the correlation between the volatilities typically drops significantly. Nonetheless, the the key empirical result (i.e, the opposite impact of the sectoral volatilities on growth and prices) is robust to altering these implementation choices, and to other proxies of sectoral volatilities that have a low correlation. For example, Table OA.1.12 shows the summary of the main empirical results when the growth rates in sales dispersion of the consumption sector and the investment sector are used as sectoral volatility shocks. While the signs of the results are largely unchanged, the correlation between the sectoral growth of sale-dispersion is only 0.5. Similarly, in Table OA.1.7, when the variables used to predict future realized variances are augmented with the market return and P/D ratio, the correlation between the sectoral volatility shocks is 0.79, which is lower than under the benchmark case. In Table OA.1.10, when IST and its volatility are used (instead of investment TFP-volatility), the correlation between consumption TFP-volatility and IST-volatility shocks is only 0.28. These robustness checks show that the opposite implications of the sectoral volatilities are not driven by a high correlation: the high correlation is merely an artifact of the benchmark methodology of measuring the volatilities.

Figure OA.1.1 presents the orthogonal investment TFP-volatility, obtained from the residuals of a projection of investment TFP-volatility on consumption TFP-volatility. The orthogonal investment TFP-volatility is procyclical and persistent, suggesting that the independent component bears an economically meaningful interpretation.

Next, I use a Monte-Carlo simulation exercise to rule-out a scenario in which a single volatility process drives the sectoral TFPs conditional volatility, and that the opposite signs on the empirical sectoral-volatilities are spurious. Specifically, I solve a model which is identical to the benchmark model, but in which the correlation between the consumption and the investment TFP-volatility shocks is one (that is, there is only one volatility process). I simulate multiple model samples of the same length as the empirical one. For each sample, I compute the model-implied sectoral TFP growth rates, as if the econometrician does not observe the true TFPs. The computation of the sectoral TFPs is done using the same methodology as in Basu et al. (2006), from model-simulated data on aggregate and sectoral output, capital, labor, and the relative price of investment goods. From the model-implied sectoral TFPs, I construct sectoral TFP-volatilities in an identical fashion to the empirical methodology (i.e., equations (1) - (2)). In other words, the volatilities are contructed as if the econometrician does not observe the true volatilities, but follows my empirical strategy step-by-step. Due to these multiple estimation stages, the "estimated" sectoral TFP-volatilities are not perfectly correlated. Using these model-implied first- and second- moment TFP shocks, I repeat projections (3) and (6). The slope coefficients for the sectoral volatility shocks are reported in Table OA.1.5. Under the Null conjecture of this model, one should not find that the sectoral volatilities predict future growth with opposite signs.

The median model-implied loadings on consumption and investment TFP-volatility are *both* positive, in predicting future consumption and output growth rates. When predicting future investment growth, the median loadings are both negative, for all predictive horizons with the exception of one-quarter ahead. The confidence intervals in Table OA.1.5 show that for all growth projections, the TFP-volatilities' slope coefficients are not statistically distinguishable from zero. In the median case, the sign of the market return's exposure to consumption TFP-volatility and investment TFP-volatility is negative. The simulation exercise suggests that neither estimation noise, nor the fact that the simulated volatilities are almost perfectly correlated, spuriously generates the opposite signs on the two volatilities, as observed in the data.

Lastly, the orthogonalization between the sectoral volatilities presented in Figure OA.1.1 can be refined further. Specifically, the two sectoral volatilities can be driven by three distinct components: a common (aggregate) volatility process, and two separate (sector-specific) volatilities that are orthogonal to the common component. To obtain these three components I first construct a measure of aggregate TFP-volatility, capturing the predictable component of future aggregate TFP realized variance. The construction of the aggregate volatility follows the same steps taken to construct the sectoral TFP-volatilities, as specified in Section 3.1. For clarification, I briefly outline these steps below.

First, I obtain a time-series of the aggregate TFP from Basu et al. (2006). I filter the aggregate TFP growth rate using an AR(k) filter. The order k is chosen by Akaike Information Criterion. Let $\{\varepsilon_{agg,t}\}$ be the residuals obtained from this filtration. Second, I construct aggregate-productivity realized variances RV_{agg}, from the aggregate TFP residuals over a window of W quarters:

$$RV_{j,t-W+1\to t} = \Sigma_{\tau=t-W+1}^{t} \varepsilon_{agg,\tau}^{2} \tag{A.7}$$

Third, I project future aggregate log realized variance on a set of predictors, denoted by $\Gamma_{agg,t}$:

$$\log(RV_{agg,t+1\to t+W}) = c_0 + c'\Gamma_{agg,t} + error \tag{A.8}$$

The set of predictors, $\Gamma_{agg,t}$, includes all variables used in the benchmark projection of future sectoral TFP realized variances (i.e., consumption and investment TFP growth rates, and consumption and investment TFP-volatilities), as well as the lagged value of the aggregate TFP realized variance. Aggregate TFP-volatility is the exponentiated fitted value of projection (A.8), $V_{agg} = exp(\hat{c}_0 + \hat{c}'\Gamma_{agg})$.

To obtain the components of the sectoral TFP-volatilities that are orthogonal to the common aggregate TFP-volatility, I project each contemporaneous sectoral volatility onto the aggregate one:

$$V_{j,t} = const + c_{agg,j}V_{agg,t} + v_{j,t}^{ortho}, \quad j \in \{C, I\} \tag{A.9}$$

The residual, $v_{j,t}^{ortho}, \quad j \in \{C, I\}$, is the sector-specific component of each sectoral TFP-volatility which is orthogonal from the common volatility. I denote these orthogonal volatility components by j-TFP-VOL$^{ortho}, \quad j \in \{C, I\}$)

Table OA.1.3 shows a summary of the results when three volatilities (i.e., the common-aggregate and the two sector-specific volatilities) are used as factors. Similarly to the benchmark results, the sector-specific component of consumption (investment) TFP-volatility predicts future growth of consumption, GDP, investment, wages and hours negatively (positively). The market price of risk, and the market beta of consumption (investment) TFP-volatility, which is sector-specific, is negative (positive). The common-aggregate volatility shares the negative signs of the sector-specific consumption TFP-volatility. It predicts a decline in key macro variables, and carries a negative market price of risk (though not statistically significant). The separation of the two sectoral volatilities into three distinct components increases the adjusted R^2's in the various projections only marginally, compared to Table **2**. The signs of the market-prices of risk and market betas to the first-moment TFP innovations reported in Table OA.1.3 are identical to the signs obtained from the benchmark analysis in Table **7**. Overall, Table OA.1.3 demonstrates that the part of the investment sector's volatility which is sector-specific, and uncorrelated with the common volatility, is associated with higher growth and asset valuations. Table OA.1.4 shows that the same conclusion holds when capacity-utilization adjusted TFP time-series are used for the aggregate and sector-specific volatilities construction.

OA.1.5. Model Sensitivity Analysis

The benchmark model relies on sticky prices to ensure that consumption would fall in response to consumption TFP-volatility shock (thus, yielding comovement with investment). It also features a high relative risk aversion to target the level of the equity premium. This section provides sensitivity analysis for consumption's impulse-responses and for the asset-pricing implications, to the parameters governing time-varying markups and risk-aversion.

The Role of Price Rigidities. Panel A of Figure OA.1.7 shows the impulse response of consumption to a one standard deviation shock in consumption TFP-volatility, under the benchmark calibration ($\phi_P = 250$), and when the price rigidity parameter ϕ_P is reduced to 50 and to 10. When ϕ_P is 50, consumption still drops in response to higher consumption TFP-volatility, and the impulse-response is negative for all predictive horizons. Qualitatively, this is consistent with the negative sign observed in the data, and implies that consumption comoves with investment expenditures, which fall as well. This suggest that even a model that features a low degree of prices stickiness can rationalize why consumption drops *shortly* after the volatility of the consumption sector rises. However, the impulse-response function is muted in absolute value compared to the benchmark case. Close to 10 quarters after the initial shock the impulse-response becomes close to zero, while in the data, the persistence of the impact of consumption TFP-volatility on consumption is larger. When ϕ_P is reduced further to 10, the impulse response is counter-factually positive up to 20 quarters ahead, although the positive effect is attenuated compared to a case with no price rigidities (see Figure **4**). The parameter ϕ_P must be sufficiently large to allow for enough time-variation in the consumption sector's markups, which makes the impulse-response negative. Columns (2) and (3) or Table OA.1.6 show the asset-pricing moments when the price rigidity parameter is reduced to 50 and 10, respectively. When ϕ_P is 50, the equity premium and market prices of risk are very close to the benchmark case. This is consistent with the fact that when ϕ_P is 50, consumption still *drops* in response to consumption TFP-volatility. However, when ϕ_P is set to 10, the equity premium falls to 4.93%. The market price of risk of consumption TFP-volatility is still negative, but significantly smaller in absolute value compared to the benchmark calibration. As consumption does not fall when consumption TFP-volatility rises, whenever ϕ_P is 10, the volatility shock does not decrease the continuation utility as much, resulting in a less negative market price of risk.

The Role of Markups. In Panel B of Figure OA.1.7 I plot the impulse response from consumption TFP-volatility shock to consumption under modified calibrations which are closer to the perfect competition case. Specifically, I consider a calibration where average markups are either 20% ($\mu = 5$), or 10% ($\mu = 10$). Importantly, both of these values are below the values used in the literature (see e.g. Bilbiie et al. (2007)). In general, the closer the markups are to zero, the smaller is the rationing effect of monopolistic power on firms' production capacity and labor demand. This rationing effect is key to cause consumption to drop when consumption TFP-volatility rises. Consistently, when the markups shrink, the impulse response functions becomes less negative. However, the difference compared to the benchmark case is small. When the markups are 20% the impulse response is qualitatively consistent with the empirical evidence, yet slightly weaker than the benchmark calibration. When the markups are 10% only the sign of the impulse-response is empirically-consistent, but not the persistence. The asset-pricing moments corresponding to the cases where the markups are reduced to 20% and 10% are reported in columns (4) and (5) of Table OA.1.6, respectively. The equity premium is slightly smaller in comparison to the benchmark case. This happens partly as the market exposure to investment TFP first-moment innovations becomes significantly more negative. Investment TFP first-moment shocks have two opposite effect on firms. On one hand, an improvement in investment technology implies that it is easier to replace the installed capital of firms. This supply effect has a negative impact on the worth of firms' assets in place. On the other hand, a positive investment shock reduces the cost of capital goods which increases firms' monopolistic rents. When the markups shrink, the monopolistic rents arising from enhanced investment technology are smaller, and the exposure of firms to investment first-moment shocks is primarily driven by their negative impact on assets in place. The market-prices of risk of volatility shocks are attenuated in magnitude, but are not particularly sensitive to the variations in the level of markups. It is the fluctuations of markups, not their unconditional level, that is quantitatively important.

The Role of Risk Aversion. Panel C of Figure OA.1.7 shows how consumption responds to a positive consumption TFP-volatility shock when the relative risk aversion γ is lower and equals to 10. Qualitatively, the impulse-response function is still negative and persistent, as in the benchmark case, but quantitatively diminished. With lower risk aversion, the household still becomes more impatient when consumption TFP-volatility rises, though by a smaller degree (the concavity in the expression of $\tilde{\beta}$ attenuates; see Section 4.2.1). This implies that wages do not drop as much, and hence, firms' markups rise by a smaller amount in comparison to a scenario with higher risk aversion. As the rise in markups is attenuated, so is the fall in consumption. Consistently with the muted impulse-response of consumption to the volatility shock, column (6) of Table OA.1.6 shows that the equity premium is much smaller compared to the benchmark case, and amounts to 1.6% per annum. The betas and market prices of risk for all shocks have the same sign as their benchmark counterparts. The market prices of risk of the volatility shocks are still greater in magnitude compared to the first-moment shocks (note that the volatility processes are still highly persistent in an Epstein and Zin (1989) environment). Importantly, though an equity premium of 1.6% is low, absent the volatility shocks the implied equity premium should be proportional to the degree of risk aversion multiplied by consumption's variance ($\approx 10 \cdot 2\%^2 = 0.4\%$). Thus, the majority of the equity premium still comes from volatility risk premia.

The Role of Cross-Volatility Correlations. For clarity and parsimony, in the benchmark model the sectoral TFP-volatility shocks are orthogonal. In the data however, these shocks are positively correlated (see Table **1**). To assess the impact of this correlation on quantities, I introduce to the model a correlation of 0.85 between the sectoral volatility shocks.[4] For this modified calibration, the impulse response of consumption to consumption TFP-volatility is shown

[4] I also reduce the parameter τ by 80%, in order to keep the feedback from investment TFP-volatility to future consumption TFP on similar magnitude.

in Panel D of Figure OA.1.7, and the asset pricing implications are reported in column (7) of Table OA.1.6. As the two volatility shock affect consumption in an opposite way they *partly* offset each other. As a consequence, consumption's response to the volatility shock is weakened but negative for all predictive horizons. A similar attenuation pattern happens with respect to investment TFP-volatility. The equity premium is sizable, but reduced to 2.76%. For the volatility shocks, the market prices of risk, and market exposures maintain their signs, but are smaller in absolute value compared to the benchmark case.[5] In Section OA.1.4 I provide further discussion on how the cross-correlation between the volatilities impacts the results.

The Role of IES. In Figure OA.1.5, I plot the impulse-responses for two cases: (1) the benchmark calibration (IES = 1.7); (2) A calibration that is identical to the benchmark case, but in which there is no monopolistic competition or volatility feedback, and in which IES is set to 0.8. When the IES is less than one, the impact of either consumption TFP-volatility or investment TFP-volatility on macro quantities is qualitatively similar. When the IES is less than one, the income effect dominates, and higher consumption TFP-volatility acts as a preference shock that increases the household *patience* (see Section 4.2.1). With more consumption TFP-volatility, the household desires to invest more. By contrast, when the IES is greater than one the volatilities have a *differential* effect, consistently with the data.

Other sensitivity checks. In untabulated results I confirm that for all price stickiness parameters, markups parameters, and risk aversion parameters that I considered in the sensitivity analysis, consumption TFP-volatility reduces investment (investment drops even in a perfect-competition setup). Thus, as long as consumption drops when consumption TFP-volatility rises, comovement is established.

In the data, the positive impact of investment TFP-volatility on detrended consumption is significant from about one year ahead onward (see Table **5**), consistent with the impulse-response of the benchmark model. Figure OA.1.8 shows a sensitivity analysis of the impulse-response of consumption to a one standard deviation shock in investment TFP-volatility. Under lower price rigidities, lower markups, or high volatility correlation, investment TFP-volatility still triggers an overshoot in future consumption. However, it takes more periods for the impulse-response to become positive (i.e., about 15 quarters), compared to the benchmark calibration.

OA.1.6. Empirical Robustness

I consider various robustness checks regarding the construction of the ex-ante sectoral volatilities. First, I consider different predictors for predicting future realized variances, as in projection (2). I add to the benchmark predictors additional variables such as the market-price dividend ratio and the market portfolio return. The summary of the key results are shown in Table OA.1.7. In this Table, the evidence for the macroeconomic regressions is for a predictive horizon of eight quarters, representing as an "average" predictive horizon. The loadings on the volatilities and the market prices of risk are similar to the benchmark results. The correlation between consumption and investment TFP

[5]Note that the market prices of risk in Table OA.1.6 are orthogonalized by the inverse of the shocks' variance-covariance matrix, similarly to the data. Even though the reported market prices of risk in column (7) of Table OA.1.6 drop by a relatively small amount, the covariance term between consumption and investment TFP-volatility shocks contributes negatively to the equity premium. As a consequence, the equity premium shrinks by roughly 60%.

volatility shocks drops to only 0.79. In unreported results, I consider other sets of predictors, such as including the risk-free rate as an additional predictor. In all cases, the results are broadly unchanged. I also consider a different window for the realized variances construction, as in equation (1). In Table OA.1.8, I show that the key results are robust when the window is expanded to six years (24 quarters).

Next, I consider using the total ex-ante volatilities as risk-factors in the various projections, as opposed to their first-difference. Separately, I consider replacing investment TFP and its volatility by investment specific technology (IST) shocks (measured by the ratio between investment to consumption TFP) and its volatility. The key results for the sectoral volatilities are still robust, and are reported in Tables OA.1.9 and OA.1.10. For the latter case, the correlation between consumption and investment (specific) TFP volatility shocks is only 0.28. In Table OA.1.11 I restrict the sample to start at 1964 (Modern Sample), a common practice in asset-pricing papers, and find similar results.

I also consider the usage of a different proxy for sectoral volatilities. Specifically, I split the universe of Compustat firms into consumption (non-durables and services) and investment sectors, according to the classifications of Gomes et al. (2009). I then consider the dispersion of sales for consumption firms, versus the dispersion of sales for investment firms, as proxies for the two-sectors' technological volatilities. The summary results are reported in Table OA.1.12. Notably, dispersion differs from time-series conditional volatility of aggregate shocks. Yet, I obtain results that are similar qualitatively to the benchmark case. Sales dispersion of consumption firms generates a contractionary impact on capital expenditures, and is negatively priced, while the opposite happens for sales dispersion of investment firms. The sectoral sales dispersion interact with consumption and output with the same signs as in the benchmark analysis, but the slope coefficients are only significant at the level of 10% in this case. The correlation between sale dispersion growth of the consumption and the investment sectors is only 0.51.

It is worth noting that while the sign of the market price of risk of investment TFP first-moment innovations is positive in the benchmark case, in some of the robustness checks it turns negative. In the model section, I adopt the view that investment TFP innovations are positively priced, as the sign is positive in *most* of the robustness checks. More relevant to this study, the signs of the TFP volatilities' betas, and their market-prices of risk are robust features of the data.

Supplemental Tables and Figures For Section OA.1

Table OA.1.1

Sectoral Shocks and Investment-Specific Technology

The Table shows the evidence from the projection of future quarterly (Panel A) and annual (Panel B) growth rates of investment-technology shock (IST) proxies on the current sectoral shocks: consumption TFP innovation, ΔC-TFP, investment TFP innovation, ΔI-TFP, consumption TFP-volatility shock, ΔC-TFP-VOL, and investment TFP-volatility shock, ΔI-TFP-VOL. The predictive projection is: $\frac{1}{h}\sum_{j=1}^{h}\Delta IST_{t+j} = \beta_0 + \beta_h'[\Delta\text{C-TFP}_t, \Delta\text{I-TFP}_t, \Delta\text{C-TFP-VOL}_t, \Delta\text{I-TFP-VOL}_t] + error$. The Table reports the slope coefficients β_h, $t-$statistics, and the adjusted R^2s for the predictive horizons of $h = 1, 4, 8, 12$ and 20 quarters. Standard errors are Newey-West adjusted. The proxy of Basu, Fernald and Kimball for IST shocks is the negative of the price deflator of equipment goods (including durables) divided by the price deflator of non-durable and services. The proxy of Israelsen for IST shock is the negative of the relative price of investment goods (excluding durables), adjusted for changes in the quality of investment technology. Annual data are from 1949-2014. Quarterly growth data are from 1947Q2-2014Q2. The quarterly growth rate for Israelsen's proxy is obtained by evenly interpolating the annual IST growth rate over four quarters.

Offset	$\beta_{\text{C-TFP}}$	$\beta_{\text{I-TFP}}$	$\beta_{\text{C-TFP-VOL}}$	$\beta_{\text{I-TFP-VOL}}$	$Adj-R^2$
Panel A: Quarterly Projections					
IST of Basu, Fernald, and Kimball (2006):					
1Q Ahead	-101.69 [-7.53]	105.15 [7.04]	3.54 [1.85]	-3.38 [-1.46]	0.26
4Q Ahead	-98.69 [-3.92]	116.65 [5.89]	3.29 [1.26]	-2.44 [-0.79]	0.32
8Q Ahead	-98.48 [-3.28]	110.05 [4.71]	4.72 [1.93]	-4.29 [-1.55]	0.28
12Q Ahead	-99.62 [-2.92]	102.05 [3.48]	5.27 [2.11]	-5.17 [-1.88]	0.25
20Q Ahead	-109.44 [-2.96]	102.95 [3.05]	6.83 [2.76]	-7.03 [-2.68]	0.27
IST of Israelsen (2012):					
1Q Ahead	-93.21 [-4.45]	93.48 [5.73]	6.38 [2.41]	-6.27 [-2.20]	0.20
4Q Ahead	-101.97 [-4.73]	118.67 [4.97]	5.01 [3.28]	-4.22 [-2.37]	0.33
8Q Ahead	-76.54 [-2.81]	91.08 [4.34]	3.32 [1.21]	-2.81 [-0.87]	0.19
12Q Ahead	-79.02 [-2.66]	81.39 [3.45]	4.18 [1.72]	-4.11 [-1.47]	0.15
20Q Ahead	-83.64 [-2.46]	74.00 [2.66]	5.32 [1.95]	-5.73 [-1.92]	0.14
Panel B: Annual Projections					
IST of Basu, Fernald, and Kimball (2006):					
1Y Ahead	-180.71 [-6.22]	170.70 [7.50]	11.18 [2.84]	-11.84 [-2.50]	0.64
8Y Ahead	-112.54 [-2.25]	94.95 [2.31]	9.42 [2.10]	-10.81 [-1.91]	0.19
20Y Ahead	-56.97 [-1.67]	30.25 [1.73]	12.17 [2.52]	-14.13 [-2.36]	0.04
IST of Israelsen (2012):					
1Y Ahead	-99.65 [-4.04]	111.93 [3.58]	6.36 [2.69]	-6.10 [-1.93]	0.24
8Y Ahead	-70.46 [-1.72]	53.76 [2.12]	11.50 [2.97]	-13.65 [-2.54]	0.08
20Y Ahead	-69.17 [-2.66]	34.05 [2.54]	13.25 [3.99]	-15.33 [-3.74]	0.08

Table OA.1.2

Sectoral Shocks and Aggregate/IST Volatilities

The Table shows the evidence from the projection of contemporaneous aggregate and IST volatility shocks on the current sectoral shocks: consumption TFP innovation, ΔC-TFP, investment TFP innovation, ΔI-TFP, consumption TFP-volatility shock, ΔC-TFP-VOL, and investment TFP-volatility shock, ΔI-TFP-VOL. The projection takes the form: $\Delta VOL_t = \beta_0 + \beta_h' [\Delta\text{C-TFP}_t, \Delta\text{I-TFP}_t, \Delta\text{C-TFP-VOL}_t, \Delta\text{I-TFP-VOL}_t] + error$, where VOL is either aggregate TFP volatility or investment-specific technology (IST) volatility. All volatilities are ex-ante realized variations, constructed via equations (3.1) and (3.2). Data on aggregate volatility, and on IST volatility from Basu, Fernald, and Kimball (2006) are from 1949Q2-2014Q2. Data on IST volatility based on Israelsen (2012) are from 1949Q2-2012Q4.

$\beta_{\text{C-TFP}}$	$\beta_{\text{I-TFP}}$	$\beta_{\text{C-TFP-VOL}}$	$\beta_{\text{I-TFP-VOL}}$	$Adj-R^2$
Aggregate TFP Volatility:				
-0.80 [-0.46]	-4.43 [-3.02]	1.12 [4.27]	-0.74 [-2.72]	0.63
IST Volatility (based on Basu, Fernald, and Kimball (2006) measure):				
-3.20 [-1.44]	-2.20 [-1.49]	-0.85 [-3.08]	1.11 [3.37]	0.36
IST Volatility (based on Israelsen (2012) measure):				
-10.56 [-6.16]	7.74 [5.31]	-0.33 [-1.28]	0.48 [1.51]	0.23

Table OA.1.3

Results Based on Three Volatilities

The Table presents the summary of the macroeconomic and asset-pricing implications of sectoral shocks, when volatility is decomposed into three components: aggregate (common) TFP volatility, as well as consumption/investment TFP volatilities that are orthogonal to the common TFP-volatility component. Panel A documents the slope coefficients, $t-$statistics and the R^2 in the projections of one to twelve quarters ahead macroeconomic growth rates on consumption TFP innovation, ΔC-TFP, investment TFP innovation, ΔI-TFP, common (aggregate) TFP-volatility shock, ΔTFP-VOL, orthogonal-consumption TFP-volatility shock, ΔC-TFP-VOL^{ortho}, and orthogonal-investment TFP-volatility shock, ΔI-TFP-VOL^{ortho}. The dependent variables in the projections of Panel A are normalized by their standard deviations. Panel C shows the estimates of the market-prices of risks and the market return exposures to the five risk factors, constructed and reported as in Table **7**. In Panel A and B loadings on the sectoral orthogonal volatilities are divided by a factor of 100.

Offset	$\beta_{\text{C-TFP}}$	$\beta_{\text{I-TFP}}$	$\beta_{\text{TFP-VOL}}$	$\beta_{\text{C-TFP-VOL}^{ortho}}$	$\beta_{\text{I-TFP-VOL}^{ortho}}$	R^2
Panel A: Macroeconomic growth rate predictability						
Consumption Growth:						
1Q Ahead	22.65 [1.74]	3.72 [0.28]	-0.76 [-1.42]	-19.75 [-0.43]	49.26 [1.13]	0.09
4Q Ahead	63.70 [3.31]	-35.68 [-2.17]	-0.94 [-1.68]	-70.17 [-1.54]	78.33 [1.66]	0.09
8Q Ahead	66.70 [3.39]	-40.91 [-2.35]	-0.62 [-1.37]	-82.23 [-2.19]	88.95 [2.19]	0.08
12Q Ahead	67.74 [2.84]	-48.52 [-2.78]	-1.04 [-2.49]	-67.31 [-1.80]	72.90 [1.79]	0.09
GDP Growth:						
1Q Ahead	32.00 [2.64]	17.91 [1.53]	0.15 [0.32]	-89.37 [-2.66]	110.32 [3.11]	0.11
4Q Ahead	62.72 [3.07]	-32.16 [-1.84]	-1.05 [-1.94]	-56.19 [-1.49]	60.88 [1.51]	0.11
8Q Ahead	58.15 [2.58]	-41.47 [-1.96]	-0.78 [-1.37]	-46.94 [-1.29]	48.21 [1.21]	0.06
12Q Ahead	59.45 [2.34]	-46.03 [-2.39]	-1.15 [-2.70]	-44.69 [-1.16]	46.99 [1.13]	0.07
Capital investment Growth:						
1Q Ahead	27.79 [2.19]	35.47 [3.02]	0.61 [1.15]	-39.20 [-0.86]	56.88 [1.29]	0.19
4Q Ahead	51.97 [2.37]	-18.55 [-0.98]	-1.07 [-2.06]	-30.96 [-0.64]	44.26 [0.92]	0.12
8Q Ahead	51.55 [1.72]	-33.68 [-1.36]	-1.07 [-2.00]	-38.75 [-0.71]	47.09 [0.86]	0.06
12Q Ahead	52.56 [1.62]	-41.89 [-1.53]	-1.32 [-2.80]	-35.62 [-0.77]	41.93 [0.87]	0.06
Capex Growth:						
1Q Ahead	-25.33 [-1.04]	22.33 [1.19]	-2.64 [-2.58]	-153.79 [-1.64]	131.87 [1.43]	0.08
4Q Ahead	26.45 [0.55]	28.90 [0.81]	-0.63 [-0.66]	-199.54 [-1.87]	187.22 [1.85]	0.07
8Q Ahead	54.76 [1.12]	7.54 [0.18]	-0.26 [-0.22]	-249.89 [-2.77]	240.41 [2.78]	0.05
12Q Ahead	48.32 [1.32]	8.81 [0.20]	-0.42 [-0.33]	-180.83 [-2.81]	180.78 [2.82]	0.04
Wage Growth:						
1Q Ahead	34.59 [2.45]	-11.12 [-0.90]	-0.35 [-0.73]	-97.29 [-2.48]	98.76 [2.45]	0.03
4Q Ahead	63.61 [3.43]	-50.42 [-2.70]	-0.95 [-1.51]	-88.77 [-2.82]	95.39 [2.82]	0.07
8Q Ahead	70.93 [3.77]	-59.50 [-3.20]	-1.04 [-1.91]	-80.78 [-2.83]	82.42 [2.66]	0.09
12Q Ahead	66.20 [2.76]	-55.35 [-2.67]	-0.85 [-1.63]	-79.12 [-2.42]	78.16 [2.25]	0.08
Hours Growth:						
1Q Ahead	52.05 [4.07]	6.80 [0.51]	-0.21 [-0.39]	-106.53 [-2.61]	125.67 [2.83]	0.17
4Q Ahead	67.01 [2.81]	-38.05 [-1.88]	-1.16 [-2.20]	-52.71 [-1.23]	58.49 [1.31]	0.11
8Q Ahead	69.81 [2.44]	-52.00 [-2.05]	-1.02 [-1.74]	-72.85 [-1.72]	72.32 [1.61]	0.09
12Q Ahead	74.91 [2.33]	-66.10 [-2.48]	-1.60 [-2.94]	-57.75 [-1.26]	60.75 [1.26]	0.12
Panel B: Asset-pricing implications						
Market betas	3.17 [10.53]	-1.38 [-5.14]	-0.04 [-4.17]	-2.37 [-2.34]	3.08 [3.40]	
Market prices of risk	0.21 [0.26]	2.10 [2.42]	-0.01 [-0.17]	-8.27 [-5.14]	11.49 [6.28]	

Table OA.1.4

Results Based on Three Volatilities: Utilization Adjusted TFP Data

The Table presents the summary of the macroeconomic and asset-pricing implications of sectoral shocks, when volatility is decomposed into three components: aggregate (common) TFP volatility, as well as consumption/investment TFP volatilities that are orthogonal to the common TFP-volatility component. The TFP time-series is *utilization adjusted*. Panel A documents the slope coefficients, $t-$statistics and the R^2 in the projections of one to twelve quarters ahead macroeconomic growth rates on consumption TFP innovation, ΔC-TFP, investment TFP innovation, ΔI-TFP, common (aggregate) TFP-volatility utilization-adjusted shock, ΔTFP-VOL, orthogonal-consumption TFP-volatility shock, ΔC-TFP-VOL^{ortho}, and orthogonal-investment TFP-volatility shock, ΔI-TFP-VOL^{ortho}. The dependent variables in the projections of Panel A are normalized by their standard deviations. Panel C shows the estimates of the market-prices of risks and the market return exposures to the five risk factors, constructed and reported as in Table **7**. In Panel A and B loadings on the sectoral orthogonal volatilities are divided by a factor of 100.

Offset	$\beta_{\text{C-TFP}}$	$\beta_{\text{I-TFP}}$	$\beta_{\text{TFP-VOL}}$	$\beta_{\text{C-TFP-VOL}^{ortho}}$	$\beta_{\text{I-TFP-VOL}^{ortho}}$	R^2
Panel A: Macroeconomic growth rate predictability						
Consumption Growth:						
1Q Ahead	30.78 [2.22]	1.93 [0.14]	-1.04 [-1.09]	-14.67 [-0.25]	37.39 [0.70]	0.07
4Q Ahead	66.31 [3.24]	-34.44 [-2.00]	-1.24 [-1.35]	-73.26 [-1.41]	75.72 [1.45]	0.08
8Q Ahead	69.26 [3.23]	-40.94 [-2.23]	-0.97 [-1.15]	-80.20 [-2.15]	85.28 [2.12]	0.07
12Q Ahead	70.85 [2.74]	-47.26 [-2.49]	-1.43 [-1.61]	-66.71 [-1.89]	68.67 [1.79]	0.08
GDP Growth:						
1Q Ahead	41.36 [3.27]	8.37 [0.67]	-0.91 [-0.96]	-70.50 [-2.23]	96.55 [2.87]	0.13
4Q Ahead	69.09 [3.05]	-34.84 [-1.77]	-1.99 [-2.06]	-47.82 [-1.28]	51.77 [1.29]	0.11
8Q Ahead	66.81 [2.71]	-48.84 [-2.12]	-2.25 [-2.24]	-31.63 [-0.91]	36.45 [0.95]	0.07
12Q Ahead	66.51 [2.40]	-49.21 [-2.26]	-2.24 [-2.52]	-33.88 [-0.93]	36.56 [0.92]	0.07
Capital investment Growth:						
1Q Ahead	39.77 [3.03]	19.82 [1.62]	-0.99 [-1.09]	-16.00 [-0.41]	41.57 [1.11]	0.22
4Q Ahead	59.93 [2.43]	-22.03 [-1.05]	-1.95 [-1.99]	-25.30 [-0.49]	34.14 [0.68]	0.11
8Q Ahead	57.23 [1.73]	-34.77 [-1.29]	-1.72 [-1.67]	-34.23 [-0.65]	39.14 [0.73]	0.05
12Q Ahead	56.55 [1.57]	-39.77 [-1.36]	-1.70 [-1.66]	-34.91 [-0.81]	36.10 [0.80]	0.05
Capex Growth:						
1Q Ahead	-20.32 [-0.86]	26.13 [1.43]	-3.87 [-2.49]	-150.93 [-1.47]	119.09 [1.23]	0.07
4Q Ahead	25.18 [0.54]	29.16 [0.81]	-1.01 [-0.58]	-218.54 [-1.95]	200.95 [1.87]	0.07
8Q Ahead	50.94 [1.03]	8.73 [0.21]	-0.22 [-0.12]	-274.72 [-3.11]	260.60 [3.03]	0.06
12Q Ahead	46.23 [1.18]	11.86 [0.27]	-0.03 [-0.01]	-205.41 [-3.59]	195.57 [3.44]	0.05
Wage Growth:						
1Q Ahead	39.36 [2.61]	-15.96 [-1.29]	-1.30 [-1.56]	-85.63 [-1.97]	91.72 [2.16]	0.03
4Q Ahead	67.44 [3.46]	-50.65 [-2.73]	-1.51 [-1.84]	-85.98 [-2.59]	90.07 [2.67]	0.06
8Q Ahead	75.77 [3.79]	-61.39 [-3.20]	-1.92 [-2.19]	-75.37 [-2.32]	76.06 [2.38]	0.09
12Q Ahead	70.21 [2.62]	-57.58 [-2.48]	-1.72 [-1.57]	-74.39 [-2.21]	73.42 [2.11]	0.08
Hours Growth:						
1Q Ahead	63.94 [4.61]	-5.85 [-0.42]	-1.90 [-2.04]	-89.41 [-2.29]	111.36 [2.83]	0.20
4Q Ahead	72.78 [2.75]	-39.87 [-1.78]	-2.00 [-1.95]	-49.82 [-1.13]	51.62 [1.16]	0.11
8Q Ahead	78.02 [2.54]	-58.37 [-2.16]	-2.52 [-2.46]	-59.33 [-1.52]	61.41 [1.45]	0.10
12Q Ahead	83.77 [2.40]	-69.44 [-2.43]	-2.95 [-2.91]	-46.26 [-1.10]	48.33 [1.10]	0.13
Panel B: Asset-pricing implications						
Market betas	3.38 [10.40]	-1.42 [-2.94]	-0.05 [-1.74]	-2.52 [-3.49]	2.89 [3.69]	
Market prices of risk	0.90 [1.88]	2.00 [3.34]	-0.07 [-1.76]	-9.43 [-5.85]	11.53 [6.75]	

Table OA.1.5

Monte-Carlo Projections: Perfectly Correlated Volatilities

The Table shows the Monte-Carlo evidence of macro growth projections, and market-volatility betas, in a model in which the correlation between the true underlying consumption and investment TFP-volatilities is one. For an economic variable of interest y, the table reports the model-implied loadings on the sectoral volatility shocks (constructed identically as in the empirical section), in the projection of future growth rates of y, on the current sectoral shocks: consumption and investment TFP innovations, consumption TFP-volatility shock, C-TFP-VOL, and investment TFP-volatility shock, I-TFP-VOL. The predictive projection is: $\frac{1}{h}\sum_{j=1}^{h}\Delta y_{t+j} = \beta_0 + \beta_h'[\Delta\text{C-TFP}_t, \Delta\text{I-TFP}_t, \Delta\text{C-TFP-VOL}_t, \Delta\text{I-TFP-VOL}_t] + error.$ The variables of interest y includes consumption, output, and investment growth rates. The predictive horizons are h varies from 1 to 20 quarters. Market betas are based on projection of contemporaneous market returns on the contemporaneous sectoral shocks. The Table reports finite-sample estimates (corresponding to 5%, 50% and 95% percentiles of the simulations' distribution) of the slope coefficients and R^2s. Aggregate and sectoral TFP first-moment growth rates are constructed from simulated model data of output, capital, labor, and the relative price of investment goods, using the same methodology as in Basu, Fernald and Kimball (2006) and Fernald (2012). Sectional TFP volatility shocks are then computed from the extracted TFP growth rate time-series, in an identical fashion to the empirical benchmark construction, as described in Section 3.2. The evidence is based on 10,000 simulations of 252 observations of quarterly data.

	$\beta_{\text{C-TFP-VOL}}$			$\beta_{\text{I-TFP-VOL}}$			R^2		
Offset	Med	CI		Med	CI		Med	CI	
Consumption Growth:									
1Q	1.83	[-19.36,	20.55]	0.42	[-5.97,	5.96]	0.16	[0.08,	0.27]
4Q	1.52	[-18.91,	20.24]	0.47	[-5.98,	5.61]	0.21	[0.10,	0.37]
8Q	1.75	[-18.70,	18.28]	0.37	[-5.34,	5.53]	0.20	[0.07,	0.38]
12Q	1.61	[-18.13,	17.18]	0.29	[-4.73,	5.10]	0.18	[0.06,	0.37]
20Q	1.22	[-13.64,	14.70]	0.26	[-3.88,	4.01]	0.15	[0.04,	0.35]
Output Growth:									
1Q	1.43	[-15.33,	15.64]	0.25	[-4.20,	4.51]	0.09	[0.02,	0.18]
4Q	1.17	[-14.93,	16.36]	0.25	[-4.20,	4.39]	0.10	[0.03,	0.24]
8Q	0.97	[-14.37,	14.89]	0.24	[-3.94,	3.99]	0.10	[0.02,	0.25]
12Q	0.72	[-13.52,	13.88]	0.18	[-3.81,	3.69]	0.08	[0.01,	0.25]
20Q	0.58	[-12.47,	12.10]	0.08	[-3.06,	3.49]	0.07	[0.00,	0.25]
Investment Growth:									
1Q	0.58	[-51.84,	58.42]	-0.29	[-16.07,	14.96]	0.00	[0.01,	0.03]
4Q	-0.89	[-48.56,	50.20]	-0.04	[-13.32,	14.39]	0.03	[0.01,	0.10]
8Q	-0.96	[-44.29,	46.44]	-0.42	[-12.45,	12.73]	0.04	[0.01,	0.16]
12Q	-1.34	[-42.41,	41.77]	-0.34	[-11.24,	11.60]	0.05	[0.00,	0.18]
20Q	-1.08	[-35.80,	32.38]	-0.31	[-9.04,	10.34]	0.06	[0.00,	0.22]
Market Beta:									
0Q	-0.34	[-4.60,	4.53]	-0.12	[-1.36,	1.22]	0.91	[0.88,	0.93]

Table OA.1.6

Model Sensitivity Analysis: Model-Implied Asset Pricing Moments

The Table presents asset-pricing moments, as well as model-implied market-prices of risk, and market risk exposures (betas), to consumption TFP innovation risk (C-TFP shock $\varepsilon_{c,t}$), investment TFP innovation risk (I-TFP shock $\varepsilon_{i,t}$), consumption TFP-volatility risk (C-TFP-VOL shock $\varepsilon_{\sigma,c,t}$) and investment TFP-volatility risk (I-TFP-VOL shock $\varepsilon_{\sigma,i,t}$). The results are reported for the benchmark model, we well as for models with identical calibration to the benchmark case, except for featuring different price rigidity parameters ϕ_P (columns 2, 3), different markup values μ (columns 4, 5), different risk aversion γ (columns 6), and different correlation between consumption and investment TFP-volatility (columns 7). The reported market prices of risks are divided by 100. The construction of market-prices of risk and betas is described in section 5.3.

	(1) Benchmark	(2) $\phi_P = 50$	(3) $\phi_P = 10$	(4) $\mu = 5$	(5) $\mu = 10$	(6) $\gamma = 10$	(7) $Corr = 0.85$
Unconditional moments							
Risk free rate	1.37	1.23	1.25	1.40	1.28	1.91	2.07
Equity Premium	6.64	6.40	4.93	5.98	5.58	1.58	2.76
Market Prices of Risk							
C-TFP	0.25	0.24	0.20	0.24	0.25	0.10	0.25
I-TFP	0.10	0.09	0.08	0.09	0.09	0.04	0.10
C-TFP-VOL	-58.89	-55.06	-37.99	-55.11	-50.75	-9.29	-40.89
I-TFP-VOL	55.05	53.48	46.42	53.38	55.00	24.86	42.56
Market Betas							
C-TFP	0.59	0.70	0.83	0.61	0.67	0.60	0.59
I-TFP	-0.02	-0.02	-0.06	-0.05	-0.20	-0.01	-0.03
C-TFP-VOL	-123.77	-110.60	-85.33	-115.71	-112.23	-48.94	-117.08
I-TFP-VOL	57.65	68.29	82.69	58.43	55.87	91.54	43.37

Table OA.1.7

Summary Results Based on Different Predictors of Future Volatility

The Table presents the summary of the macroeconomic and asset-pricing implications of sectoral shocks, using alternative construction of ex-ante TFP volatilities, in which the set of predictive variables Γ_t includes the benchmark predictors, as well as the market price-dividend ratio, and the market return. Panel A documents the slope coefficients, $t-$statistics and the R^2 in the projections of 8-quarters ahead macroeconomic growth rates on consumption TFP innovation, ΔC-TFP, investment TFP innovation, ΔI-TFP, consumption TFP-volatility shock, ΔC-TFP-VOL, and investment TFP-volatility shock, ΔI-TFP-VOL. Panel B shows the evidence from projecting 8-quarters ahead average business-cycle component of macroeconomic variables on the sectoral innovations and volatility shocks. Panel C shows the estimates of the market-prices of risks and the market return exposures to the four risk factors, constructed and reported as in Table **7**. In Panels A and B the loadings on the sectoral volatilities are multiplied by a factor of 10.

Offset	$\beta_{\text{C-TFP}}$	$\beta_{\text{I-TFP}}$	$\beta_{\text{C-TFP-VOL}}$	$\beta_{\text{I-TFP-VOL}}$	R^2
Panel A: Macroeconomic growth rate predictability					
Consumption growth	0.21 [3.30]	-0.13 [-2.56]	-0.04 [-2.99]	0.05 [2.46]	0.072
GDP growth	0.29 [2.53]	-0.19 [-2.04]	-0.06 [-2.84]	0.06 [1.92]	0.062
Capital investment growth	0.65 [1.67]	-0.37 [-1.24]	-0.17 [-1.95]	0.14 [1.23]	0.053
Capex growth	0.47 [0.58]	0.25 [0.35]	-0.19 [-1.51]	0.18 [1.16]	0.024
Relative price growth	0.36 [2.35]	-0.39 [-3.30]	-0.05 [-1.37]	0.07 [1.67]	0.101
Wage growth	0.27 [3.89]	-0.21 [-3.35]	-0.05 [-2.48]	0.05 [2.36]	0.075
Hours growth	0.34 [2.36]	-0.23 [-2.05]	-0.01 [-3.10]	0.01 [2.00]	0.090
Panel B: Macroeconomic business-cycle predictability					
Detrended consumptio	0.87 [1.04]	0.10 [0.16]	-0.24 [-1.49]	0.26 [1.14]	0.048
Detrended GDP	1.02 [1.53]	-0.04 [-0.08]	-0.27 [-1.97]	0.30 [1.53]	0.067
Detrended capital investment	3.72 [1.45]	-0.48 [-0.25]	-0.93 [-1.80]	1.18 [1.66]	0.058
Detrended capex	2.36 [0.70]	1.76 [0.50]	-0.54 [-1.05]	0.68 [1.21]	0.040
Detrended relative price	0.65 [1.30]	-0.75 [-1.63]	-0.07 [-0.73]	0.06 [0.56]	0.053
Detrended wage	0.15 [0.43]	-0.10 [-0.35]	-0.04 [-0.59]	-0.01 [-0.09]	-0.008
Detrended hours	1.14 [1.64]	-0.31 [-0.55]	-0.03 [-1.99]	0.04 [1.82]	0.053
Panel C: Asset-pricing implications					
Market prices of risk	-6.70 [-7.86]	6.82 [10.46]	-0.09 [-3.52]	0.06 [1.44]	
Market betas	2.55 [8.90]	-2.57 [-13.50]	-0.37 [-3.95]	0.11 [4.08]	

Table OA.1.8

Summary Results Based on Different Window in Construction of Realized Variances

The Table presents the summary of the macroeconomic and asset-pricing implications of sectoral shocks, using alternative construction of ex-ante volatilities, in which the sectoral TFP realized variances are computed over a window of 24 quarters (six years). Panel A documents the slope coefficients, $t-$statistics and the R^2 in the projections of 8-quarters ahead macroeconomic growth rates on consumption TFP innovation, ΔC-TFP, investment TFP innovation, ΔI-TFP, consumption TFP-volatility shock, ΔC-TFP-VOL, and investment TFP-volatility shock, ΔI-TFP-VOL. Panel B shows the evidence from projecting 8-quarters ahead average business-cycle component of macroeconomic variables on the sectoral innovations and volatility shocks. Panel C shows the estimates of the market-prices of risks and the market return exposures to the four risk factors, constructed and reported as in Table **7**.

Offset	$\beta_{\text{C-TFP}}$	$\beta_{\text{I-TFP}}$	$\beta_{\text{C-TFP-VOL}}$	$\beta_{\text{I-TFP-VOL}}$	R^2
Panel A: Macroeconomic growth rate predictability					
Consumption growth	0.24 [3.18]	-0.13 [-2.05]	-0.01 [-2.47]	0.02 [2.20]	0.075
GDP Growth	0.27 [2.06]	-0.14 [-1.22]	-0.02 [-2.21]	0.02 [1.92]	0.040
Capital investment growth	0.95 [1.96]	-0.43 [-1.14]	-0.07 [-2.33]	0.08 [2.12]	0.087
Capex growth	0.99 [1.55]	0.20 [0.41]	-0.16 [-2.85]	0.22 [2.64]	0.050
Relative price growth	0.31 [1.52]	-0.42 [-2.64]	0.00 [0.15]	-0.01 [-0.68]	0.102
Wage growth	0.23 [2.73]	-0.19 [-2.17]	-0.01 [-1.45]	0.01 [1.07]	0.051
Hours growth	0.38 [1.91]	-0.22 [-1.39]	-0.02 [-2.09]	0.03 [1.89]	0.085
Panel B: Macroeconomic business-cycle predictability					
Detrended consumption	1.05 [1.23]	0.28 [0.48]	-0.14 [-1.99]	0.18 [2.07]	0.072
Detrended GDP	1.33 [2.09]	-0.00 [-0.00]	-0.14 [-2.96]	0.19 [2.97]	0.101
Detrended capital investment	5.45 [2.05]	-0.36 [-0.23]	-0.62 [-2.64]	0.81 [2.60]	0.103
Detrended capex	4.96 [1.61]	1.86 [0.45]	-0.89 [-2.02]	1.24 [1.89]	0.083
Detrended relative price	-0.13 [-0.28]	-0.19 [-0.37]	0.05 [1.80]	-0.06 [-1.70]	0.024
Detrended wage	0.27 [0.65]	0.03 [0.08]	-0.02 [-0.67]	0.03 [0.68]	0.005
Detrended hours	1.61 [2.62]	-0.37 [-0.76]	-0.16 [-3.08]	0.21 [2.93]	0.101
Panel C: Asset-pricing implications					
Market prices of risk	-0.88 [-0.72]	2.85 [3.44]	-0.46 [-1.68]	0.84 [2.18]	
Market betas	2.76 [13.65]	-0.69 [-3.27]	-0.13 [-4.73]	0.21 [5.56]	

Table OA.1.9

Summary Results Based on Total Ex-Ante Volatilities as Factors

The Table presents the summary of the macroeconomic and asset-pricing implications of sectoral factors, using the (total) ex-ante sectoral TFP volatilities as risk-factors, as opposed to their shocks (first differences) as in the benchmark case (with $W = 20$). Panel A documents the slope coefficients, $t-$statistics and the R^2 in the projections of 8-quarters ahead macroeconomic growth rates on consumption TFP innovation, ΔC-TFP, investment TFP innovation, ΔI-TFP, consumption TFP-volatility, C-TFP-VOL, and investment TFP-volatility, I-TFP-VOL. Panel B shows the evidence from projecting 8-quarters ahead average business-cycle component of macroeconomic variables on the sectoral innovations and ex-ante volatilities. Panel C shows the estimates of the market-prices of risks and the market return exposures to the four risk factors, constructed and reported as in Table **7**.

Offset	$\beta_{\text{C-TFP}}$	$\beta_{\text{I-TFP}}$	$\beta_{\text{C-TFP-VOL}}$	$\beta_{\text{I-TFP-VOL}}$	R^2
Panel A: Macroeconomic growth rate predictability					
Consumption growth	0.43 [0.90]	-0.33 [-0.69]	-24.54 [-1.46]	20.20 [3.34]	0.198
GDP growth	1.43 [2.30]	-1.32 [-2.11]	-61.61 [-2.69]	31.84 [3.35]	0.146
Capital investment growth	4.19 [4.62]	-3.76 [-4.10]	-171.22 [-4.79]	85.18 [4.48]	0.169
Capex growth	3.75 [0.85]	-3.01 [-0.64]	-183.04 [-0.74]	96.93 [0.41]	0.034
Relative price growth	-0.15 [-0.27]	0.12 [0.23]	-15.09 [-0.79]	30.02 [3.13]	0.266
Wage growth	-0.00 [-0.01]	0.07 [0.15]	-9.51 [-0.55]	16.75 [1.66]	0.163
Hours growth	2.07 [6.82]	-1.95 [-6.19]	-74.99 [-5.96]	29.67 [3.64]	0.180
Panel B: Macroeconomic business-cycle predictability					
Detrended consumption	3.88 [1.67]	-2.72 [-1.16]	-226.73 [-2.25]	160.80 [1.96]	0.145
Detrended GDP	6.60 [3.72]	-5.46 [-2.99]	-312.92 [-4.06]	180.49 [2.90]	0.209
Detrended capital investment	29.52 [4.16]	-25.62 [-3.73]	-1154.43 [-4.31]	510.44 [3.67]	0.143
Detrended capex	13.22 [0.66]	-8.75 [-0.41]	-904.64 [-0.86]	697.36 [0.83]	0.069
Detrended relative price	-1.90 [-1.66]	1.71 [1.50]	73.43 [1.47]	-21.74 [-0.89]	0.034
Detrended wage	2.08 [1.81]	-2.00 [-1.75]	-79.20 [-2.00]	28.50 [1.22]	0.009
Detrended hours	7.79 [3.28]	-6.86 [-2.84]	-299.55 [-3.38]	132.53 [3.06]	0.139
Panel C: Asset-pricing implications					
Market prices of risk	13.72 [4.72]	-12.50 [-4.23]	-720.05 [-6.65]	435.18 [6.70]	
Market betas	4.60 [3.53]	-2.90 [-2.61]	-88.92 [-1.93]	38.20 [2.51]	

Table OA.1.10

Summary Results Based on IST Shocks and Its Volatility

The Table presents the summary of the macroeconomic and asset-pricing implications of sectoral shocks, when investment innovations are investment specific technology (IST) shocks (measured as the ratio between the consumption and investment TFPs), and when the investment-sector's volatility is constructed as in the benchmark case but using IST data. The sectoral TFP realized variances for both sectors are computed over a window of fifteen quarters. Panel A documents the slope coefficients, $t-$statistics and the R^2 in the projections of 8-quarters ahead macroeconomic growth rates on consumption TFP innovation, ΔC-TFP, IST innovation, ΔIST, consumption TFP-volatility shock, ΔC-TFP-VOL, and IST-volatility shock, ΔIST-VOL. Panel B shows the evidence from projecting 8-quarters ahead average business-cycle component of macroeconomic variables on the sectoral innovations and volatility shocks. Panel C shows the estimates of the market-prices of risks and the market return exposures to the four risk factors, constructed and reported as in Table **7**.

Offset	$\beta_{\text{C-TFP}}$	β_{IST}	$\beta_{\text{C-TFP-VOL}}$	$\beta_{\text{IST-VOL}}$	R^2
Panel A: Macroeconomic growth rate predictability					
Consumption growth	0.11 [2.97]	-0.00 [-1.43]	-0.01 [-2.83]	0.00 [3.27]	0.088
GDP growth	0.13 [2.30]	-0.00 [-1.07]	-0.01 [-2.12]	0.00 [2.45]	0.042
Capital investment growth	0.48 [2.75]	-0.00 [-1.35]	-0.02 [-2.06]	0.01 [3.03]	0.081
Capex growth	0.78 [1.98]	-0.00 [-2.04]	-0.02 [-0.63]	0.02 [1.71]	0.099
Relative price growth	-0.02 [-0.30]	-0.00 [-1.63]	-0.01 [-1.20]	0.00 [0.47]	0.010
Wage growth	0.07 [1.74]	0.00 [0.48]	-0.00 [-1.00]	0.00 [0.78]	0.005
Hours growth (new)	0.15 [2.23]	-0.00 [-2.29]	-0.01 [-1.49]	0.00 [3.04]	0.060
Panel B: Macroeconomic business-cycle predictability					
Detrended consumption	1.19 [2.77]	-0.00 [-1.78]	-0.04 [-1.45]	0.03 [3.31]	0.102
Detrended GDP	1.19 [4.13]	-0.00 [-1.46]	-0.03 [-1.78]	0.02 [4.11]	0.119
Detrended capital investment	3.74 [3.57]	-0.00 [-2.57]	-0.09 [-1.30]	0.07 [4.06]	0.130
Detrended capex	4.68 [2.58]	-0.00 [-3.35]	-0.26 [-1.47]	0.17 [2.68]	0.215
Detrended relative price	-0.15 [-1.06]	0.00 [3.50]	0.00 [0.60]	0.00 [0.15]	0.001
Detrended wage	0.09 [0.53]	-0.00 [-0.22]	-0.01 [-1.77]	0.00 [0.01]	0.009
Detrended hours (new)	1.05 [3.66]	-0.00 [-2.03]	-0.00 [-0.06]	0.02 [3.81]	0.120
Panel C: Asset-pricing implications					
Market prices of risk	1.31 [2.27]	-0.00 [-0.52]	-0.21 [-6.84]	0.05 [2.92]	
Market betas	1.92 [5.89]	0.00 [1.67]	-0.06 [-2.37]	0.01 [1.38]	

Table OA.1.11

Summary Results Based on Modern Subsample

The Table presents the summary of the macroeconomic and asset-pricing implications of sectoral shocks, when restricting the data to the sub-sample of 1964Q1-2014Q2. Panel A documents the slope coefficients, $t-$statistics and the R^2 in the projections of 8-quarters ahead macroeconomic growth rates on consumption TFP innovation, ΔC-TFP, investment TFP innovation, ΔI-TFP, consumption TFP-volatility shock, ΔC-TFP-VOL, and investment TFP-volatility shock, ΔI-TFP-VOL. Panel B shows the evidence from projecting 8-quarters ahead average business-cycle component of macroeconomic variables on the sectoral innovations and volatility shocks. Panel C shows the estimates of the market-prices of risks and the market return exposures to the four risk factors, constructed and reported as in Table **7**.

Offset	$\beta_{\text{C-TFP}}$	$\beta_{\text{I-TFP}}$	$\beta_{\text{C-TFP-VOL}}$	$\beta_{\text{I-TFP-VOL}}$	R^2
Panel A: Macroeconomic growth rate predictability					
Consumption growth	0.19 [2.91]	-0.09 [-1.27]	-0.01 [-1.05]	0.01 [1.40]	0.050
GDP growth	0.32 [3.44]	-0.20 [-2.14]	-0.02 [-1.91]	0.02 [2.12]	0.066
Capital investment growth	1.19 [3.37]	-0.70 [-2.19]	-0.07 [-3.70]	0.07 [3.91]	0.141
Capex growth	0.58 [0.68]	0.12 [0.15]	-0.07 [-1.67]	0.06 [1.73]	0.029
Relative price growth	0.10 [0.68]	-0.19 [-1.45]	-0.01 [-0.76]	0.00 [0.49]	0.033
Wage growth	0.04 [0.49]	-0.03 [-0.33]	0.00 [0.72]	-0.00 [-0.83]	0.014
Hours growth	0.57 [5.38]	-0.41 [-4.36]	-0.03 [-4.63]	0.03 [5.04]	0.208
Panel B: Macroeconomic business-cycle predictability					
Detrended consumption	0.86 [1.73]	-0.01 [-0.02]	-0.08 [-1.82]	0.09 [2.11]	0.091
Detrended GDP	1.21 [2.74]	-0.27 [-0.64]	-0.10 [-2.18]	0.11 [2.38]	0.119
Detrended capital investment	5.39 [2.97]	-1.72 [-1.04]	-0.39 [-4.22]	0.42 [4.75]	0.132
Detrended capex	4.32 [1.10]	0.33 [0.08]	-0.48 [-2.22]	0.52 [2.44]	0.079
Detrended relative price	0.21 [0.50]	-0.50 [-1.12]	0.01 [0.68]	-0.02 [-1.18]	0.076
Detrended wage	0.22 [0.85]	-0.20 [-0.81]	-0.01 [-0.62]	0.01 [0.50]	0.009
Detrended hours	1.79 [3.14]	-0.77 [-1.38]	-0.14 [-4.66]	0.15 [5.11]	0.131
Panel C: Asset-pricing implications					
Market prices of risk	-2.40 [-1.85]	3.11 [1.63]	-0.14 [-2.43]	0.19 [3.89]	
Market betas	4.86 [8.94]	-1.93 [-5.33]	-0.26 [-9.03]	0.34 [10.57]	

Table OA.1.12

Summary Results Based on Sale-Dispersion as Sectoral Volatility Factors

The Table presents the summary of the macroeconomic and asset-pricing implications of sectoral factors, using an alternative measure of sectoral volatilities: growth of sales dispersion in the consumption sector as a substitute for consumption TFP-volatility shock, and growth of sales dispersion in the investment sector as a substitute for investment TFP-volatility shock. Panel A documents the slope coefficients, $t-$statistics and the R^2 in the projections of 8-quarters ahead macroeconomic growth rates on consumption TFP innovation, ΔC-TFP, investment TFP innovation, ΔI-TFP, consumption sales dispersion shock, ΔC-DISP, and investment sales dispersion shock, ΔI-DISP. Panel B shows the evidence from projecting 8-quarters ahead average business-cycle component of macroeconomic variables on the sectoral innovations and sale dispersions. The slope coefficients on ΔC-DISP and ΔI-DISP are multiplied by 10. Panel C shows the estimates of the market-prices of risks and the market return exposures to the four risk factors, constructed and reported as in Table **7**. The dispersion data are quarterly from 1964Q1-2013Q4.

Offset	$\beta_{\text{C-TFP}}$	$\beta_{\text{I-TFP}}$	$\beta_{\text{C-DISP}}$	$\beta_{\text{I-DISP}}$	R^2
Panel A: Macroeconomic growth rate predictability					
Consumption growth	0.15 [2.44]	-0.06 [-0.88]	-0.06 [-1.54]	0.02 [1.50]	0.054
GDP growth	0.24 [2.67]	-0.13 [-1.43]	-0.07 [-1.56]	0.02 [1.19]	0.049
Capital investment growth	0.96 [2.71]	-0.47 [-1.56]	-0.07 [-0.65]	0.03 [0.64]	0.089
Capex growth	0.81 [1.30]	-0.03 [-0.05]	-0.26 [-1.11]	0.16 [2.07]	0.029
Relative price growth	0.52 [2.76]	-0.69 [-3.53]	-0.03 [-0.40]	0.08 [2.11]	0.107
Wage growth	0.03 [0.34]	-0.02 [-0.29]	0.01 [0.39]	0.01 [0.68]	-0.019
Hours growth	0.46 [4.16]	-0.34 [-3.75]	-0.08 [-2.10]	0.02 [1.39]	0.150
Panel B: Macroeconomic business-cycle predictability					
Detrended consumption	0.50 [1.05]	0.28 [0.67]	-0.23 [-1.10]	0.02 [0.24]	0.060
Detrended GDP	0.81 [1.89]	0.10 [0.27]	-0.35 [-1.61]	0.02 [0.23]	0.090
Detrended capital investment	3.67 [2.24]	-1.44 [-1.04]	-0.74 [-1.26]	0.17 [0.80]	0.072
Detrended capex	6.51 [2.11]	-0.62 [-0.18]	-0.65 [-0.64]	0.58 [1.85]	0.074
Detrended relative price	1.23 [3.19]	-1.10 [-3.32]	-0.33 [-2.52]	0.10 [1.66]	0.188
Detrended wage	0.16 [0.69]	-0.11 [-0.50]	-0.26 [-2.35]	0.04 [1.08]	0.024
Detrended hours	1.24 [2.37]	-0.33 [-0.66]	-0.09 [-0.41]	0.00 [0.05]	0.064
Panel C: Asset-pricing implications					
Market prices of Risk	0.84 [1.04]	0.38 [0.45]	-2.05 [-10.81]	1.19 [6.70]	
Market betas	3.85 [1.79]	-0.89 [-0.79]	-0.20 [-1.12]	0.63 [1.60]	

Table OA.1.13

Summary Results Based on August 2018 TFP Data Release

The Table presents the summary of the macroeconomic and asset-pricing implications of sectoral shocks, when the TFP data on Basu et al is based on August 2018 release. Panel A documents the slope coefficients, $t-$statistics and the R^2 in the projections of 8-quarters ahead macroeconomic growth rates on consumption TFP innovation, ΔC-TFP, investment TFP innovation, ΔI-TFP, consumption TFP-volatility shock, ΔC-TFP-VOL, and investment TFP-volatility shock, ΔI-TFP-VOL. Panel B shows the evidence from projecting 8-quarters ahead average business-cycle component of macroeconomic variables on the sectoral innovations and volatility shocks. Panel C shows the estimates of the market-prices of risks and the market return exposures to the four risk factors, constructed and reported as in Table **7**. In Panels A and B the loadings on the sectoral volatilities are multiplied by a factor of 10.

Offset	$\beta_{\text{C-TFP}}$	$\beta_{\text{I-TFP}}$	$\beta_{\text{C-TFP-VOL}}$	$\beta_{\text{I-TFP-VOL}}$	R^2
Panel A: Macroeconomic growth rate predictability					
Consumption growth	0.22 [3.18]	-0.13 [-2.35]	-0.01 [-2.53]	0.02 [2.33]	0.073
GDP growth	0.33 [2.61]	-0.21 [-1.95]	-0.02 [-2.25]	0.02 [2.00]	0.065
Capital investment growth	0.74 [1.70]	-0.42 [-1.24]	-0.04 [-1.53]	0.05 [1.42]	0.052
Capex growth	0.95 [0.94]	0.19 [0.23]	-0.11 [-2.00]	0.15 [2.17]	0.050
Relative price growth	0.35 [2.00]	-0.36 [-2.58]	-0.02 [-1.39]	0.02 [1.16]	0.105
Wage growth	0.30 [3.86]	-0.23 [-3.17]	-0.02 [-2.99]	0.02 [2.91]	0.084
Hours growth	0.38 [2.43]	-0.26 [-2.04]	-0.02 [-2.27]	0.02 [2.02]	0.094
Panel B: Macroeconomic business-cycle predictability					
Detrended consumption	1.04 [1.12]	0.11 [0.17]	-0.08 [-1.32]	0.11 [1.33]	0.054
Detrended GDP	1.27 [1.87]	0.60 [1.21]	-0.11 [-2.03]	0.16 [2.20]	0.158
Detrended capital investment	4.29 [1.47]	-0.61 [-0.29]	-0.33 [-1.73]	0.42 [1.76]	0.064
Detrended capex	6.03 [1.81]	0.07 [0.02]	-0.48 [-2.09]	0.70 [2.22]	0.111
Detrended relative price	-0.04 [-0.11]	-0.23 [-0.57]	0.03 [1.11]	-0.04 [-1.28]	0.018
Detrended wage	0.19 [0.49]	-0.14 [-0.43]	-0.01 [-0.31]	0.01 [0.18]	0.010
Detrended hours	1.30 [1.68]	-0.37 [-0.60]	-0.10 [-1.93]	0.12 [1.93]	0.059
Panel C: Asset-pricing implications					
Market prices of risk	1.96 [2.06]	1.68 [1.70]	-0.37 [-3.78]	0.64 [5.34]	
Market betas	2.77 [10.20]	-0.93 [-2.94]	-0.07 [-1.92]	0.10 [1.98]	

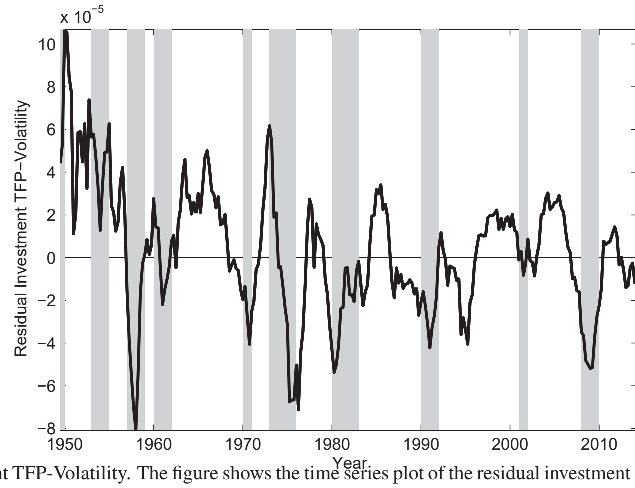


Fig. OA.1.1. Residual Investment TFP-Volatility. The figure shows the time series plot of the residual investment TFP-volatility which is orthogonal to consumption TFP-volatility. The sectoral TFP-volatilities are constructed from regressions of future sectoral TFP realized variances on a set of predictors. The predictors include smoothed consumption and investment TFP growth rates and lagged realized variances. The residual investment TFP-volatility is computed from the projection of investment TFP-volatility onto consumption TFP-volatility. The shaded areas are NBER recessions.

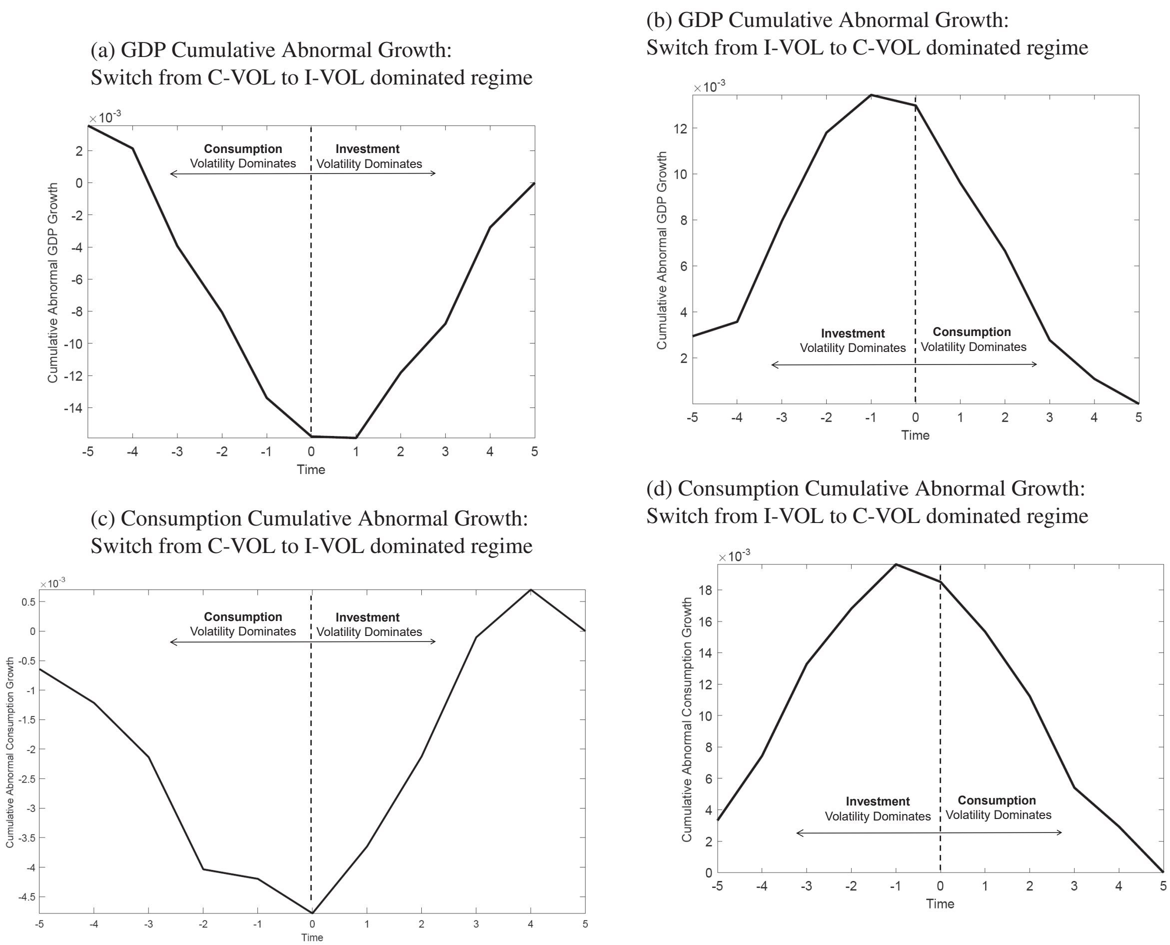


Fig. OA.1.2. Event Study Analysis of Sectoral Volatility Impact. The figure shows cumulative abnormal macroeconomic growth around events of switching between realized consumption TFP-volatility dominated regime to realized investment TFP-volatility dominated regime (Panels (a) and (c)), and vice versa (Panels (b) and (d)). Specifically, for the event 'switch to a consumption (investment) TFP-volatility dominated regime', time zero is defined as the quarter in which the difference between consumption and investment TFP realized volatilities turns positive (negative), while being negative (positive) in the last quarter. Given a set of N event dates $\{\tau_1, ..\tau_N\}$, and a macro variable of interest y the construction of the abnormal cumulative growth takes three steps: (1) compute the average of Δy for each quarter k in a window of 5 quarters around the event dates: $G_k = \frac{1}{N}\sum_{i=1}^{N} \Delta y_{\tau_i - k}, \quad k \in \{-5, .., 5\}$; (2) subtract the unconditional average of Δy to obtain abnormal growth: $AG_k = G_k - \overline{\Delta y}$; (3) compute the cumulative abnormal growth: $CAG_k = \sum_{t=-5}^{k} AG_k, \quad k \in \{-5, .., 5\}$. The variable y is GDP in Panels (a) and (b), and consumption in Panels (c) and (d).

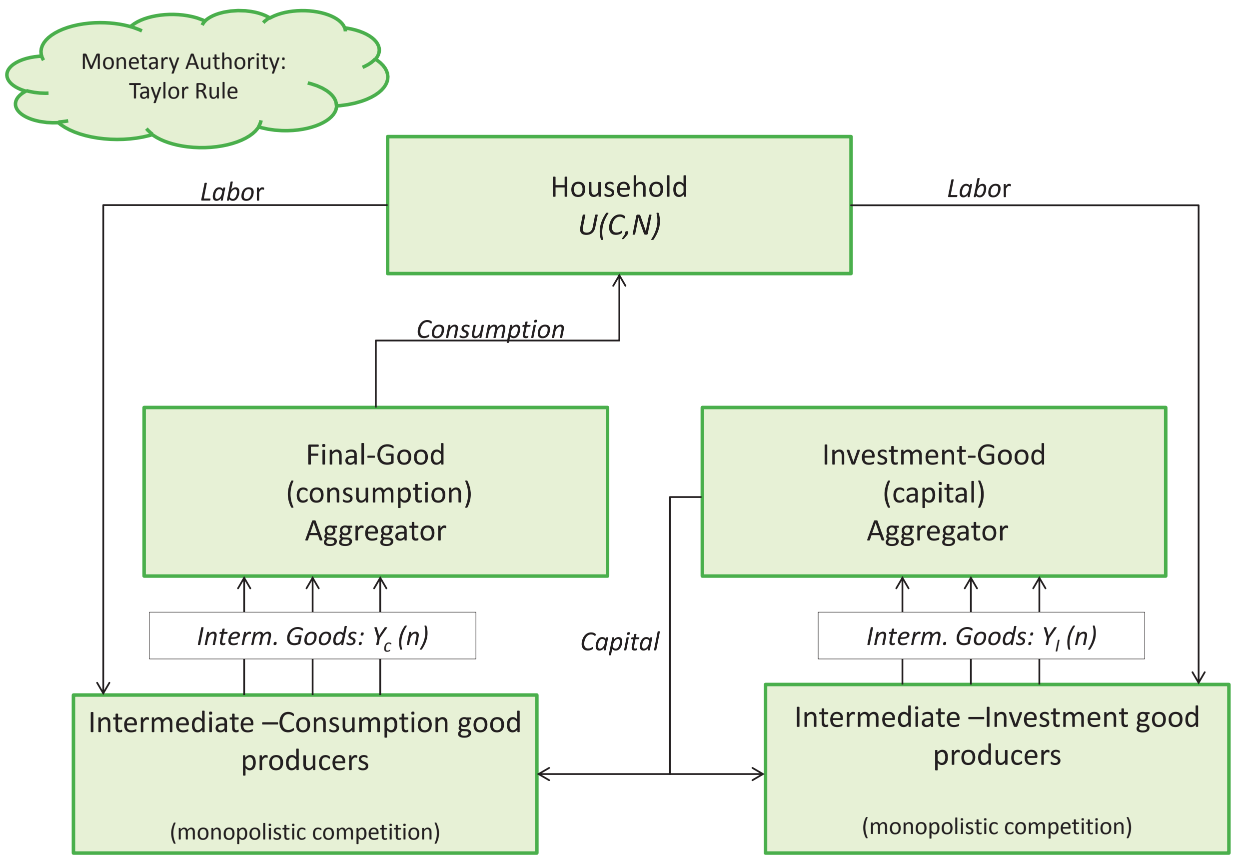
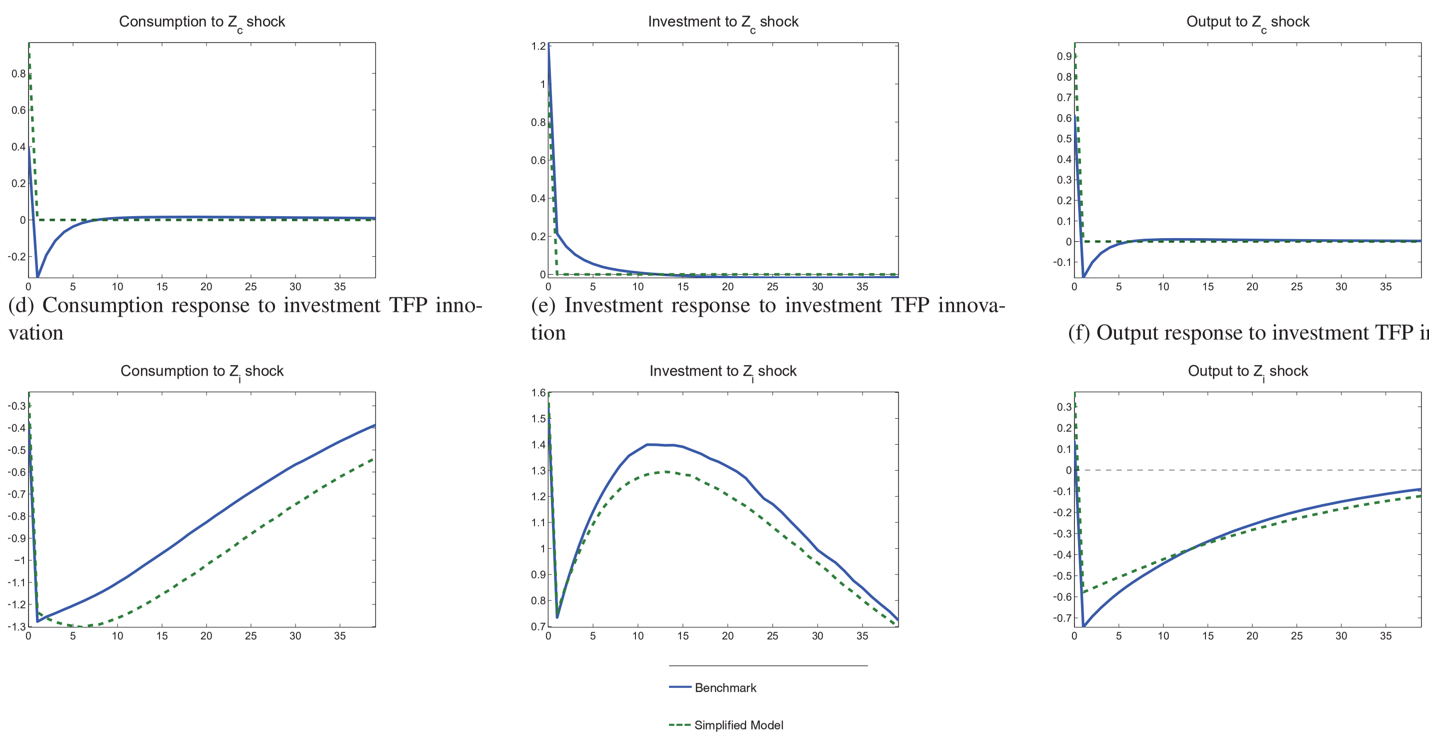


Fig. OA.1.3. Model Scheme. The figure outlines the structure of the benchmark two-sector economy.



(a) Consumption response to consumption TFP innovation

(b) Investment response to consumption TFP innovation

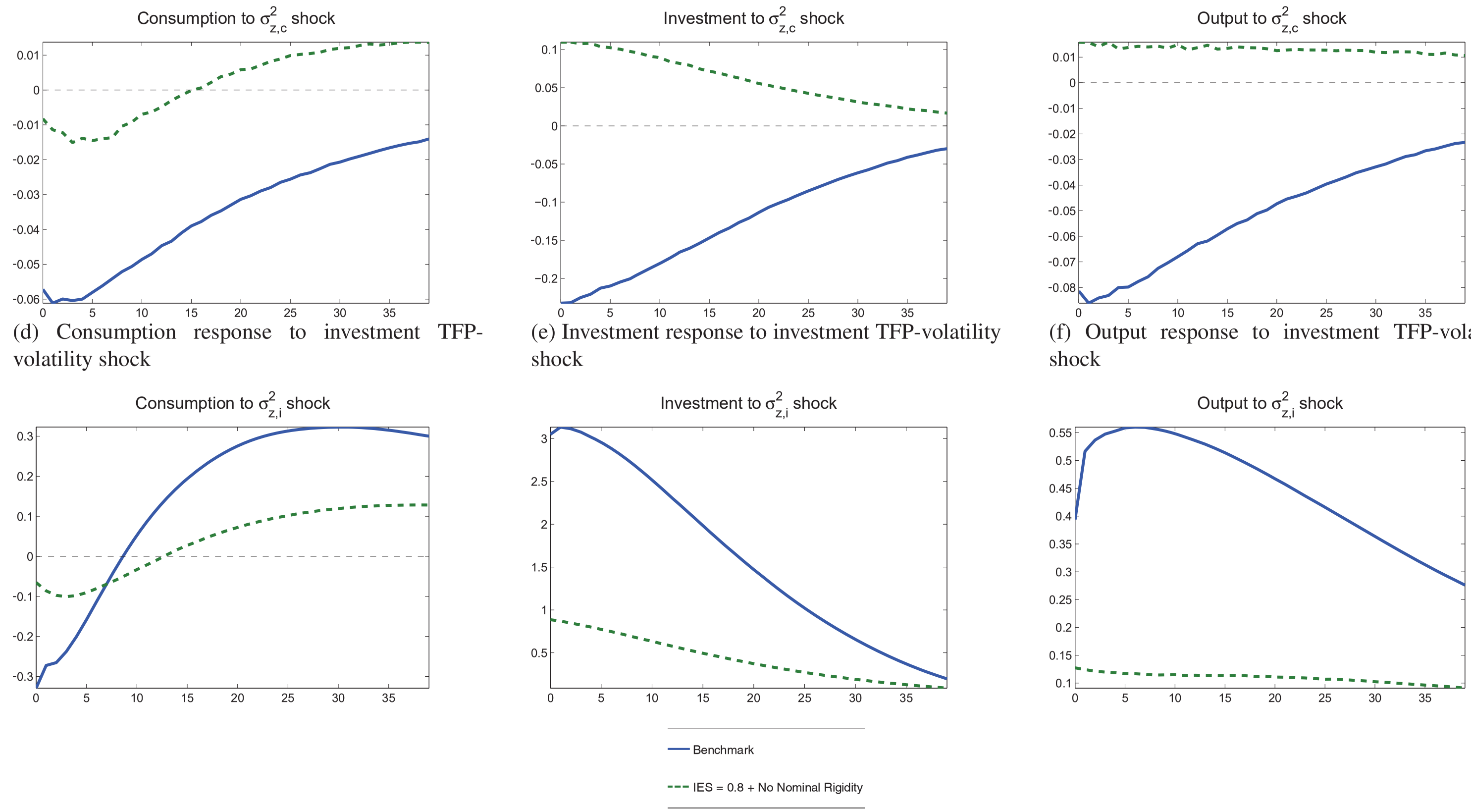
(c) Output response to consumption TFP innovation

(d) Consumption response to investment TFP innovation

(e) Investment response to investment TFP innovation

(f) Output response to investment TFP innovation

Fig. OA.1.4. Model Impulse Response of Detrended Consumption, Output and Investment to Sectoral Innovations. The Figure shows impulse responses of model-detrended consumption, investment expenditures, and output to one-standard deviation shocks of consumption TFP growth ($Z_{c,t}/Z_{c,t-1}$) and investment TFP growth ($Z_{i,t}/Z_{i,t-1}$). The impulse responses are computed using simulated model-data. The solid blue-line shows impulse-responses from the benchmark model. The dashed green line shows impulse responses from a 'simplified model', with an identical calibration as the benchmark model, but with perfect competition ($\mu_j \to \infty \quad j \in \{c, i\}$), and without a feedback from investment TFP-volatility to future consumption TFP growth ($\tau = 0$). The horizontal axis represents quarters. The vertical axis represents percent deviations from the steady-state.



(a) Consumption response to consumption TFP-volatility shock

(b) Investment response to consumption TFP-volatility shock

(c) Output response to consumption TFP-volatility shock

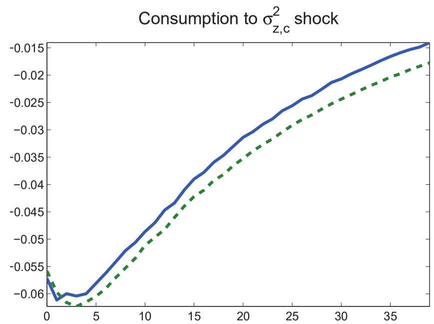
(d) Consumption response to investment TFP-volatility shock

(e) Investment response to investment TFP-volatility shock

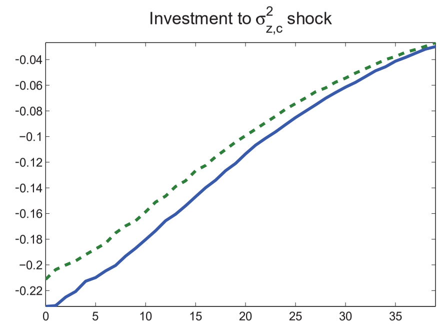
(f) Output response to investment TFP-volatility shock

Fig. OA.1.5. Model Impulse Responses to Sectoral Volatilities: The Role of IES. The Figure shows impulse responses of model-detrended consumption, investment expenditures, and output to one-standard deviation shocks of consumption TFP-volatility (σ^2_{zc}) and investment TFP-volatility (σ^2_{zi}). The impulse responses are computed using simulated model-data. The solid blue-line shows impulse-responses from the benchmark model. The dashed green line shows impulse responses from a model with an identical calibration to the benchmark model, but in which the IES (ψ) is set to 0.8, and without a feedback from investment TFP-volatility to future consumption TFP growth ($\tau = 0$), and no monopolistic competition ($\mu_j \to \infty \quad j \in \{c, i\}$). The horizontal axis represents quarters. The vertical axis represents percent deviations from the steady-state.

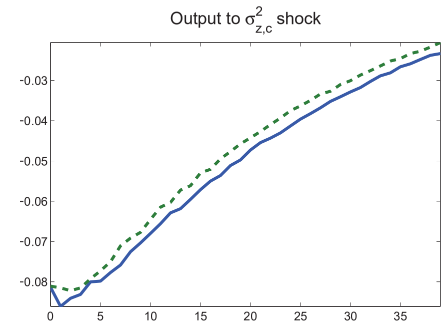
(a) Consumption response to consumption TFP-volatility shock



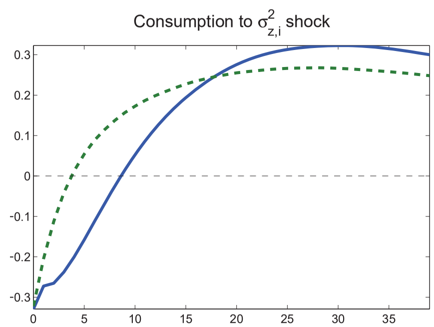
(b) Investment response to consumption TFP-volatility shock



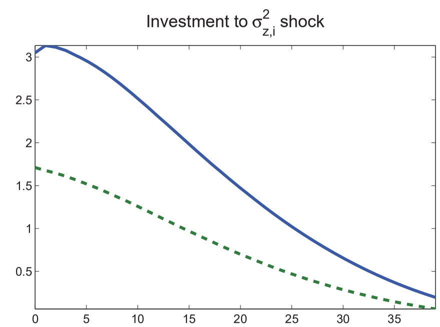
(c) Output response to consumption TFP-volatility shock



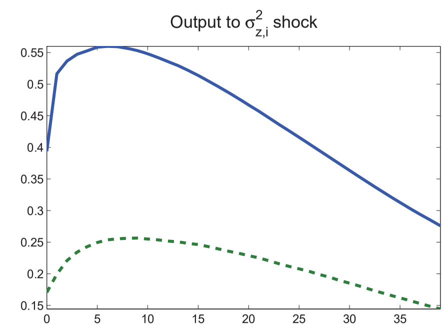
(d) Consumption response to investment TFP-volatility shock



(e) Investment response to investment TFP-volatility shock



(f) Output response to investment TFP-volatility shock



Benchmark

No Volatility Feedback

Fig. OA.1.6. Model Impulse Responses to Sectoral Volatilities: Excluding Only Volatility Feedback. The Figure shows impulse responses of model-detrended consumption, investment expenditures, and output to one-standard deviation shocks of consumption TFP-volatility (σ^2_{zc}) and investment TFP-volatility (σ^2_{zi}). The impulse responses are computed using simulated model-data. The solid blue-line shows impulse-responses from the benchmark model. The dashed green line shows impulse responses from a model with an identical calibration to the benchmark model (including monopolistic competition and sticky prices), but without a feedback from investment TFP-volatility to future consumption TFP growth ($\tau = 0$). The horizontal axis represents quarters. The vertical axis represents percent deviations from the steady-state.

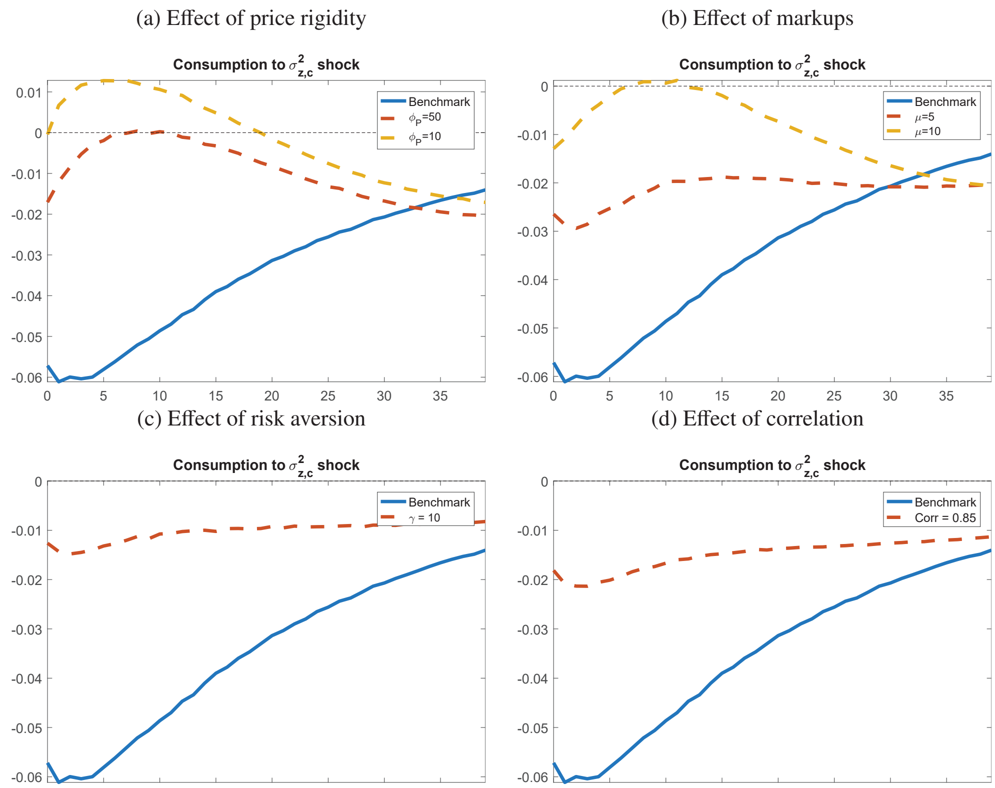


Fig. OA.1.7. Sensitivity Analysis: Model Impulse Response of Consumption TFP-Volatility on Consumption. The Figure shows impulse responses of model-detrended consumption to one-standard deviation shock of consumption TFP-volatility (σ^2_{zc}). The impulse responses are computed using simulated model-data. The solid blue-line shows impulse-responses from the benchmark model. The dashed lines shows impulse responses from calibrations that are identical to the benchmark model, but feature (1) different price rigidity parameters, ϕ_P (Panel A), (2) different markup values, μ (Panel B), (3) different relative risk aversion parameter, γ (Panel C), (4) different correlation between consumptino and investment TFP volatility shocks (Panel D). The horizontal axis represents quarters. The vertical axis represents percent deviations from the steady-state.

OA.2. Extended Model: A Model with Long-Run Risk

OA.2.1. Motivation and Setup Description

In the benchmark model, the productivity of the consumption and the investment sector follows a random-walk process (see equations A.13 and A.14). While the model-implied market-prices of risk, and risk premia, for the volatility shocks are sizable, the first-moment TFP innovations' contribution to the equity premium is much smaller. Under a random-walk specification, the first-moment shocks' risk premia tightly depends on the value of the relative risk aversion coefficient γ. To make the contribution of the first-moment TFP innovations sizable, such that the model is capable of matching the equity premium level, the benchmark calibration sets γ to 25. This value is consistent with estimates of this parameter at the quarterly frequency (see e.g. Bansal and Shaliastovich, 2013; and Van Binsbergen et al., 2012), but is considered relatively high.

In this Section I consider a small modification to the productivity dynamics of the benchmark model. The modification permits lowering the relative risk aversion coefficient to 10, while generating a sizable equity risk premium. The

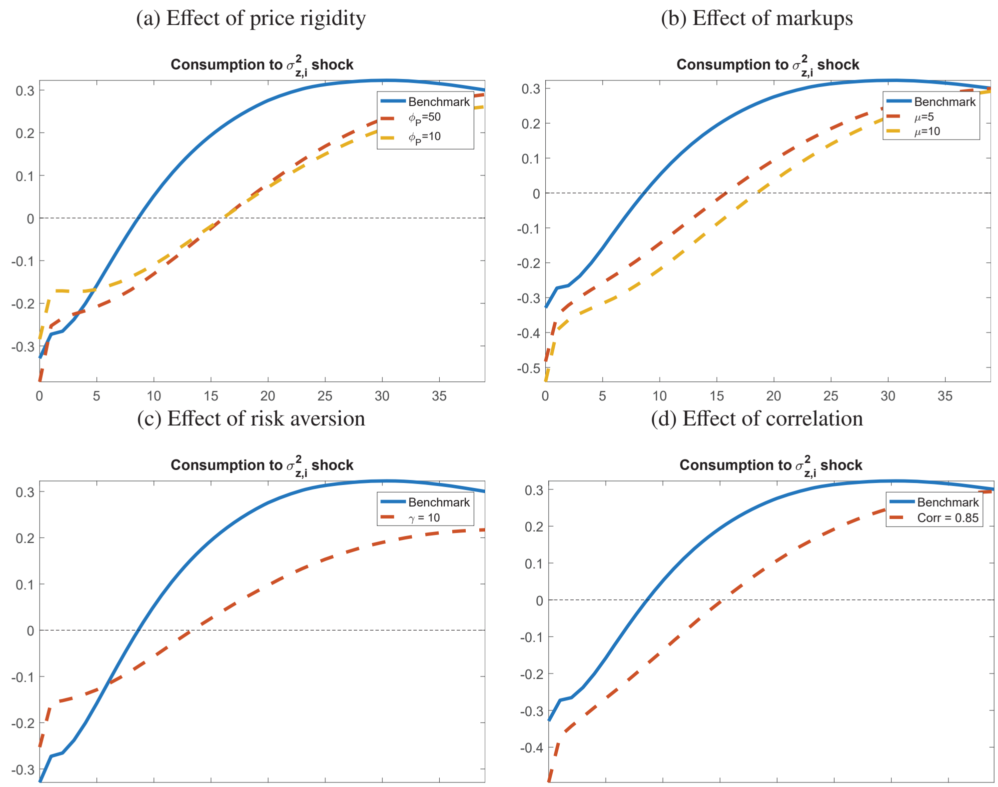


Fig. OA.1.8. Sensitivity Analysis: Model Impulse-Response of Investment TFP-Volatility on Consumption. The Figure shows impulse responses of model-detrended consumption to one-standard deviation shock of investment TFP-volatility (σ^2_{zI}). The impulse responses are computed using simulated model-data. The solid blue-line shows impulse-responses from the benchmark model. The dashed lines shows impulse responses from calibrations that are identical to the benchmark model, but feature (1) different price rigidity parameters, ϕ_P (Panel A), (2) different markup values, μ (Panel B), (3) different relative risk aversion parameter, γ (Panel C), (4) different correlation between consumptino and investment TFP volatility shocks (Panel D). The horizontal axis represents quarters. The vertical axis represents percent deviations from the steady-state.

modification also permits significantly smaller parameter values for markups and price stickiness, while maintaining the comovement of consumption and investment in-response to consumption TFP-volatility.

Specifically, I consider introducing to the model a small predictable and persistent component for productivity growth (i.e., Long-Run Risk as in Bansal and Yaron (2004), henceforth 'LRR' or 'LRR-Model'). The empirical existence of a long-run risk component in the aggregate TFP dynamics was shown by Croce (2014). As firms respond more strongly to productivity news shocks, this amplifies firms' exposures, particularly to first-moment TFP innovations. As investment responds more strongly to these news shocks, so does consumption. In other words, the sensitivity (elasticity) of consumption to time-varying markups rises, which permits a decrease in the degree of price stickiness. The rest of the intuition remains unchanged.

In this augmented model, equations A.13 and A.14 for the dynamics of $Z_{c,t}$ and $Z_{i,t}$ are replaced by:

$$\frac{Z_{i,t}}{Z_{i,t-1}} = \mu_{z,i} + x_{i,t-1} + \tilde{\varepsilon}_{i,t}, \tag{A.10}$$
$$\frac{Z_{c,t}}{Z_{c,t-1}} = \mu_{z,c} + x_{c,t-1} + \tilde{\varepsilon}_{c,t}, \tag{A.11}$$
$$x_{i,t} = \rho_x x_{i,t-1} + \phi_x \sigma_{zi,t-1} \varepsilon_{i,x,t}, \tag{A.12}$$
$$x_{c,t} = \rho_x x_{c,t-1} + \phi_x \sigma_{zc,t-1} \varepsilon_{c,x,t}, . \tag{A.13}$$

The shocks $\varepsilon_{i,x,t}$, $\varepsilon_{i,x,t}$, $\varepsilon_{i,t}$ and $\varepsilon_{c,t}$ are orthogonal, and are i.i.d. standard Normal. The expressions for $\sigma_{zi,t}$, $\sigma_{zc,t}$, $\tilde{\varepsilon}_{i,t}$, and $\tilde{\varepsilon}_{c,t}$ are identical to their definition in Section A.2.2. To keep the number of shocks in this economy the same as in the empirical Section (two first-moment shocks, two second-moment shocks), I assume that the correlation between the long-run and short-run productivity shock in each sector is one ($corr(\varepsilon_{j,t}, \varepsilon_{j,x,t}) = 1 \quad j \in \{C, I\}$).

OA.2.2. Calibration and Quantitative Results

Table OA.2.1 shows the calibration of the model with Long-Run Risk shocks. Notice that compared to the calibration in Table B.1, the calibration below features lower relative risk aversion, lower price rigidity parameter, and smaller markups.

Table OA.2.1
Calibration of the The LRR Model

The Table presents parameter choice of the model parameters in the Benchmark-LRR case.

Symbol	Value	Parameter
γ	10	Relative risk aversion
ψ	1.8	Intertemporal Elasticity of Substitution
β	0.996	Time discount factor
ξ	3	Disutility from labor
η	1.4	Sensitivity of disutility to working hours
$\alpha_c = \alpha_i$	0.33	Share of capital in output
δ	0.015	Depreciation rate
μ_{zc}	1.0019	Drift of consumption sector TFP
μ_{zi}	1.0040	Drift of investment sector TFP
$\sigma_{zc,0}$	0.01	Unconditional volatility of consumption TFP shock
$\sigma_{zi,0}$	0.02	Unconditional volatility of investment TFP shock
ρ_σ	0.95	Persistence of volatilities
μ_c	5	Markup of 20% in the consumption sector
μ_i	5	Markup of 20% in the investment sector
ϕ_P	30	Rotemberg price rigidity
π_{ss}	0.005	Steady state inflation
ρ_π	1.5	Weight on inflation gap in Taylor rule
ρ_y	0.5	Weight on output gap in Taylor rule
τ	20	Feedback from investment TFP-volatility to future consumption TFP
ρ_x	0.997	Persistence of predictable TFP growth component
ϕ_x	0.0055	Ratio between long-run and short-run volatility

Tables OA.2.2 - OA.2.4, and Figures OA.2.1 - OA.2.3 present the quantitative results from the augmented model.

These tables correspond to the benchmark tables, with largely similar quantitative and qualitative results.

Table OA.2.2

LRR-Model-Implied Macroeconomic Moments against Data Counterparts

The Table presents LRR-model-implied mean, standard deviation, and auto-correlation for key macroeconomic growth rates, against their empirical counterparts. The macroeconomic growth rates reported include (log-real rates of) consumption growth ΔC, output growth ΔY, investment-expenditures growth ΔI, and relative-price of investment growth ΔP_I. The model-implied macroeconomic moments are computed from simulated data. I simulate the model at a quarterly frequency and then time-aggregate the data to annual observations. I report median moments along with the 5% and 95% percentiles, across 10,000 simulations, each with a length of 268 quarters, similarly to the length of the data time-series. The data moments are computed using annual data from 1947-2014.

	Model (Annualized)			Data (1947-2014)		
	Mean	Std.dev.	Ac(1)	Mean	Std.dev.	Ac(1)
ΔC	1.51 [0.08, 3.05]	2.30 [1.83, 2.98]	0.56 [0.32, 0.72]	1.92	1.52	0.49
ΔY	1.50 [0.06, 3.01]	2.42 [1.92, 3.09]	0.50 [0.28, 0.69]	1.98	2.28	0.18
ΔI	1.51 [0.01, 3.05]	6.82 [5.71, 8.13]	0.32 [0.11, 0.52]	1.67	6.75	0.18
ΔP_I	-0.83 [-2.71, 1.34]	3.77 [3.08, 4.51]	0.29 [0.10, 0.48]	-0.97	3.62	0.45

Table OA.2.3

LRR-Model-Implied Pricing Moments against Data Counterparts

The Table presents LRR-model-implied mean, standard deviation, and auto-correlation for the real market excess return, R_m^e, and the real risk-free rate, R_f, against their empirical counterparts. In the model, the market excess return is levered-up using a factor of $5/3$. The model-implied macroeconomic moments are computed from simulated data. I simulate the model at a quarterly frequency and then time-aggregate the data to annual observations. I report median moments along with the 5% and 95% percentiles, across 10,000 simulations, each with a length of 268 quarters, similarly to the length of the data time-series. The data moments are computed using annual data from 1947-2014.

	Model (Annualized)			Data (1947-2014)		
	Mean	Std.dev.	Ac(1)	Mean	Std.dev.	Ac(1)
R_m^e	4.32 [3.34, 5.32]	13.10 [11.34, 13.84]	-0.03 [-0.23, 0.16]	6.20	17.63	-0.03
R_f	1.24 [0.39, 2.05]	1.14 [0.92, 1.46]	0.71 [0.56, 0.82]	0.89	1.72	0.73

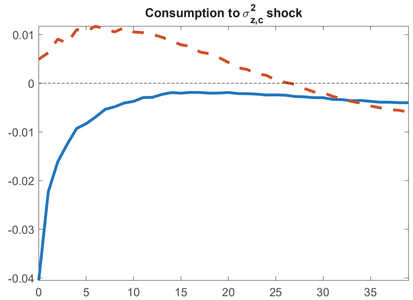
Table OA.2.4

LRR-Model-Implied Market-Prices of Risk and Risk Exposures

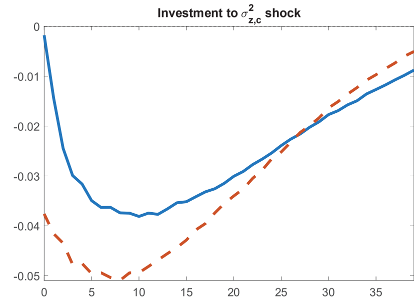
The Table presents LRR-model-implied market-prices of risk (λ) and risk exposures (β) to consumption TFP innovation risk (C-TFP shock $\varepsilon_{c,t}$), investment TFP innovation risk (I-TFP shock $\varepsilon_{i,t}$), consumption TFP-volatility risk (C-TFP-VOL shock $\varepsilon_{\sigma,c,t}$) and investment TFP-volatility risk (I-TFP-VOL shock $\varepsilon_{\sigma,i,t}$). The exposures (betas) to the risk factors are reported for consumption firms (V_c), investment firms (V_i), and the market ($V_m = V_c + V_i$). Panel A reports model implied market-prices and betas for the benchmark model. Panel B shows the results for a model with no volatility feedback ($\tau = 0$) and no monopolistic competition. The reported market prices of risks are divided by 100. The construction of market-prices of risk and betas is described in section 5.3.

	C-TFP	I-TFP	C-TFP-VOL	I-TFP-VOL
Panel A: Benchmark				
Market Prices of Risk	0.14	0.04	-34.98	27.89
Market Betas	0.90	-0.03	-170.69	109.04
Consumption Betas	0.88	-0.10	-165.36	105.46
Investment Betas	0.96	-0.00	-187.78	122.31
Panel B: Simplified Model (Perfect Competition)				
Market Prices of Risk	0.16	0.05	-34.52	-6.28
Market Betas	1.07	-0.72	-14.33	86.86
Consumption Betas	1.05	-0.76	-11.55	77.71
Investment Betas	1.10	-0.62	-20.93	108.54

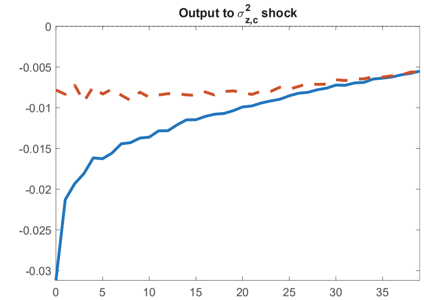
(a) Consumption response to consumption TFP-volatility shock



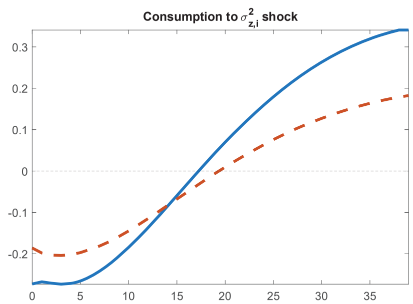
(b) Investment response to consumption TFP-volatility shock



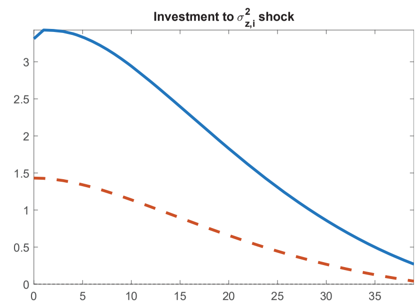
(c) Output response to consumption TFP-volatility shock



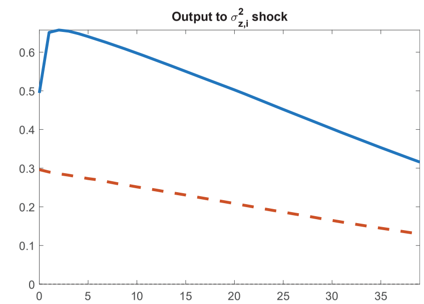
(d) Consumption response to investment TFP-volatility shock



(e) Investment response to investment TFP-volatility shock



(f) Output response to investment TFP-volatility shock



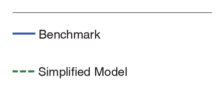
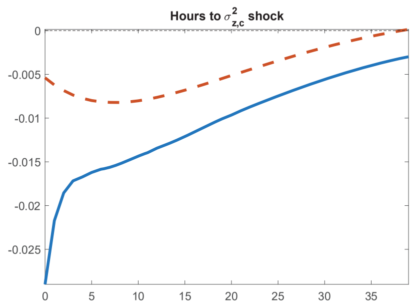
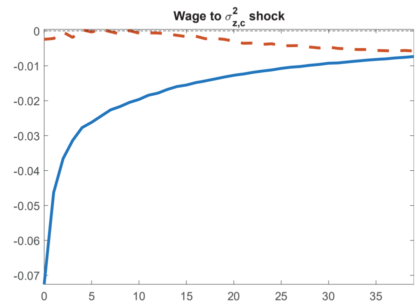


Fig. OA.2.1. LRR-Model Impulse Response of Detrended Consumption, Output and Investment to Sectoral Volatilities. The Figure shows impulse responses of model-detrended real consumption, investment expenditures, and output to one-standard deviation shocks of consumption TFP-volatility (σ^2_{zc}) and investment TFP-volatility (σ^2_{zi}). The impulse responses are computed using simulated model-data. The solid blue-line shows impulse-responses from the LRR-benchmark model. The dashed red line shows impulse responses from a 'simplified model', with an identical calibration as the LRR-benchmark model, but with perfect competition ($\mu_j \to \infty \quad j \in \{c, i\}$), and without a feedback from investment TFP-volatility to future consumption TFP growth ($\tau = 0$). The horizontal axis represents quarters. The vertical axis represents percent deviations from the steady-state.

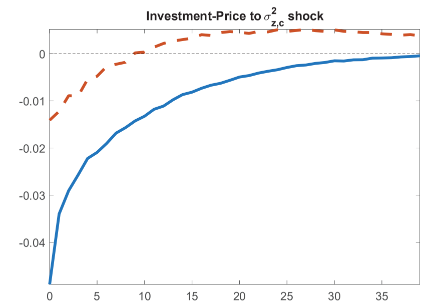
(a) Hours response to consumption TFP-volatility shock



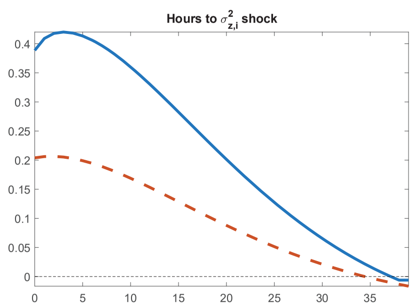
(b) Wage response to consumption TFP-volatility shock



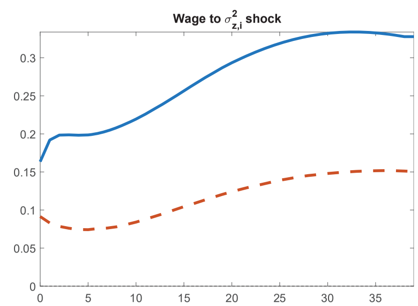
(c) Investment-price response to consumption TFP-volatility shock



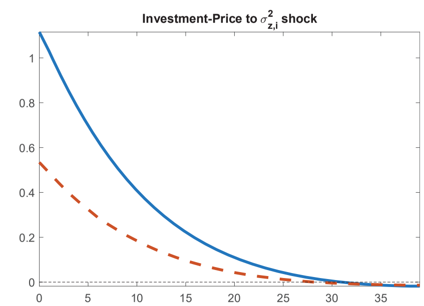
(d) Hours response to investment TFP-volatility shock



(e) Wage response to investment TFP-volatility shock



(f) Investment-price response to investment TFP-volatility shock



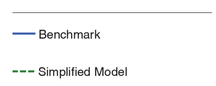
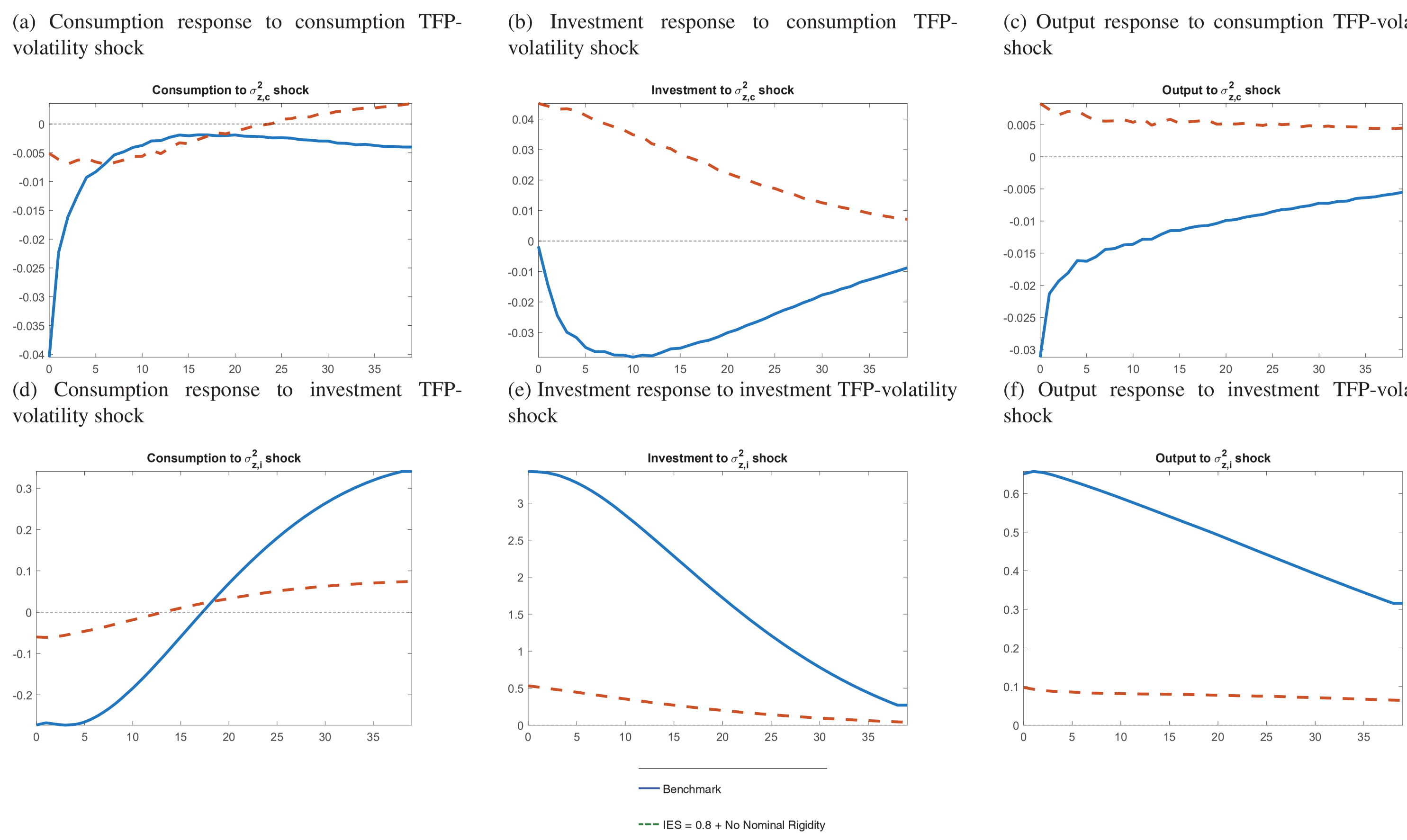


Fig. OA.2.2. LRR-Model Impulse Response of Hours, Detrended Wages and Investment-Price to Sectoral Volatilities. The Figure shows impulse responses of model-implied hours, detrended real wages, and real relative price of investment to one-standard deviation shocks of consumption TFP-volatility (σ^2_{zc}) and investment TFP-volatility (σ^2_{zi}). The impulse responses are computed using simulated model-data. The solid blue-line shows impulse-responses from the LRR-benchmark model. The dashed red line shows impulse responses from a 'simplified model', with an identical calibration as the LRR-benchmark model, but with perfect competition ($\mu_j \to \infty \quad j \in \{c, i\}$), and without a feedback from investment TFP-volatility to future consumption TFP growth ($\tau = 0$). The horizontal axis represents quarters. The vertical axis represents percent deviations from the steady-state.



(a) Consumption response to consumption TFP-volatility shock

(b) Investment response to consumption TFP-volatility shock

(c) Output response to consumption TFP-volatility shock

(d) Consumption response to investment TFP-volatility shock

(e) Investment response to investment TFP-volatility shock

(f) Output response to investment TFP-volatility shock

Fig. OA.2.3. LRR-Model Impulse Responses to Sectoral Volatilities: The Role of IES. The Figure shows impulse responses of model-detrended consumption, investment expenditures, and output to one-standard deviation shocks of consumption TFP-volatility (σ^2_{zc}) and investment TFP-volatility (σ^2_{zi}). The impulse responses are computed using simulated model-data. The solid blue-line shows impulse-responses from the LRR-benchmark model. The dashed red line shows impulse responses from a model with an identical calibration to the LRR-benchmark model, but in which the IES (ψ) is set to 0.8, and without a feedback from investment TFP-volatility to future consumption TFP growth ($\tau = 0$), and no monopolistic competition ($\mu_j \to \infty \quad j \in \{c, i\}$). The horizontal axis represents quarters. The vertical axis represents percent deviations from the steady-state.

OA.3. Investment TFP-Volatility and The Momentum Spread

The empirical analysis in the main text shows that investment TFP-volatility risk explains about 90% of the quarterly quantile-based momentum spread in the data. In this section I provide an intuition for this result. The intuition builds on two ingredients: (1) Investment TFP-volatility increases the value of real growth options; (2) Past winners have more growth options than losers. Below I examine the validity of these ingredients theoretically (qualitatively) and empirically.

OA.3.1. Economic Story

Higher priced volatility can either raise the value of a real growth option due to the convexity of the payoff, or drop its value if its impact on raising discount rates is very high (see Ai and Kiku (2012)). If the impact of investment TFP-volatility on discount rates is moderate, it behaves like an idiosyncratic volatility, and increases real growth options' values. By contrast, consumption TFP-volatility can lower the value of real growth options, if its impact on discount rates is sufficiently large.

Assume further that investment has a time-to-build structure which involves two stages. At the first stage, firms invest in R&D, which creates a project in-progress. The project-in-progress matures after some time period into a real growth option. This growth option captures a matured project, which is ready to be executed for a fixed amount. At the second stage, the firm chooses when to exercise the stock of its growth options (i.e., matured projects) by paying the fixed amount. Exercising an option increases the stock of the firm's working (productive) capital, and its future revenues.

As an intuitive example, the first stage can capture the R&D of a new product. When the development of the product is done, and all product specification are finalized, the product is ready to be marketed to the public. The second stage captures the optimal timing decision to launch the product.

Past winners (in terms of past returns) are likely to be 'lucky' firms that experienced a sequence of high productivity realizations. Higher productivity increases in each period the marginal productivity of R&D investment, and induces these winner firms to start more projects-in-progress during the *sorting* period. Thus, at the end of the sorting period, past winners are likely to have a higher stock of matured projects (i.e., more real growth options, that are ready to be executed).

Since winners have more growth options than losers, and higher investment TFP-volatility raises the value of these growth options, winners have a higher beta (exposure) to investment TFP-volatility than losers. Because investment TFP-volatility is positively priced, the expected return for winners (coming from the investment TFP-volatility channel) is higher than that for losers. This is consistent with the momentum spread.

OA.3.2. Empirical Validity

The study of Liu and Zhang (2011) shows that winner firms have a higher realized investment rate, and they also have a higher expected growth rate of investment rate, and a higher expected sales to capital ratio. This is consistent with the notion of increased stock of growth options for winner firms.

A reduced-form empirical prediction of the economic story is that winners' investment response to investment TFP-volatility shock should be lower (less positive) than that of losers. The logic is that investment TFP-volatility raises the option value of waiting (i.e., increases the value of the real growth options), and thus, inhibits (delays) exercising these real growth options today. This effect depresses some component of investment expenditures. Since winner have more real growth options than losers, their investment activity is affected more by this channel than loser firms. Likewise, winners' investment response to consumption TFP-volatility shock should be higher (less negative) than losers. This stems from the opposite logic, that consumption TFP-volatility drops the value of real growth options (through its effect on discount rates), and therefore hastens their exercise time.

To check this hypothesis, I project the following regression at the firm level. All regressors are standardized:

$$I_{i,t+1}/K_{i,t} = \alpha_i + \beta_c \Delta\text{C-TFP}_t + \beta_i \Delta\text{I-TFP}_t + \beta_{cv}\Delta\text{C-TFP-VOL}_t + \beta_{iv}\Delta\text{I-TFP-VOL}_t + \sum_{k=2}^{5} b_k(D(MOM_{i,k,t})\Delta\text{I-TFP-VOL}_t) + \sum_{k=2}^{5} c_k(D(MOM_{i,k,t})\Delta\text{C-TFP-VOL}_t) + \gamma X_t + u_{i,t}. \quad \text{(A.14)}$$

The dependent variable is the firm-level investment rate. $D(MOM_{i,k,t})$ is dummy variable, which takes the value 1 if firm i belongs to momentum portfolio $k \in [2,5]$ at time t. X_t is a set of controls which includes the dummy variables. The regressors include all sectoral shocks, and also an interaction between the sectoral volatility shock and a dummy variable of the quantile momentum portfolio to which the firm belongs. The $\{b_k\}$ ($\{c_k\}$) loadings capture the differential investment rate response to investment (consumption) TFP-volatility from winner portfolio k to the loser portfolio (portfolio 1). According to the hypothesis, $\{b_k\}$ ($\{c_k\}$) should be negative (positive), and they should increase in absolute terms with k. Below I report the regression results (using all Compustat firms).

Table OA.3.1

Summary Results Based on Relative Price of Business-Equipment as Investment Shocks

The Table reports the results of projection A.14.

β_c	β_i	β_{cv}	β_{iv}	b_2	b_3	b_4	b_5
0.0016	0.0016	-0.011	0.013	-0.0006	-0.0016	-0.0021	-0.0016
[6.78]	[6.86]	[−10.33]	[12.16]	[−0.91]	[−2.37]	[−3.10]	[−2.31]
				c_2	c_3	c_4	c_5
				0.0004	0.0014	0.0021	0.0021
				[0.58]	[2.07]	[3.04]	[2.35]