Essays on the link between asset prices and economic fluctuations

by

Ruchith Dissanayake

A thesis submitted in partial fulfillment of the requirements for the degree of

Doctor of Philosophy

in

Finance

Faculty of Business
University of Alberta

ABSTRACT

University of Alberta

Ruchith Dissanayake

The thesis consists of three essays on the link between asset prices and economic fluctuations. In Chapter 2 , I explore asset pricing implications and macroeconomic dynamics of government spending shocks. I introduce a novel exogenous measure of government spending shocks using financial data. Although consumption and investment decrease in the long run, fiscal shocks cause contemporaneously low marginal utility states. Assets with high sensitivity to government spending shocks earn significantly higher expected returns, on average, compared to assets with low sensitivity to government spending shocks. I show that the government spending shocks disproportionately worsen the value of growth opportunities relative to the value of existing assets. I develop a dynamic stochastic general equilibrium model to explain these insights.

In Chapter 3 , I use financial data to measure trade induced productivity change and assess its effects on macroeconomic dynamics and equity returns. I find that trade induced productivity leads to high marginal wealth states since, in short-run, economy reallocates resources from consumption towards exports and investment. Assets with high sensitivity to the shock have lower expected returns since they deliver

high returns when consumption is dear for investors. The negative risk premium is stronger within larger firms and high investment firms. In addition, I show that trade induced productivity contributes to economic growth, especially in the case of limited foreign import competition.

In Chapter 4 , we study how investment-specific technology shocks are priced in a large cross section of stocks from 33 countries. The investment premium is generally negative and often significant in developed countries with greater access to capital, better financial institutions, and higher product market competition, while it is largely insignificant or sometimes even significantly positive in emerging markets with opposite characteristics. The investment premium is related to, but not subsumed in, the value premium. Our results underscore the importance of economic development and allocative efficiency in the pricing of technological advances, and help reconcile the conflicting existing evidence from the U.S. market with different sample periods.

Preface

The research project in Chapter 2 was identified, designed and executed by the author under the supervision of Akiko Watanabe and Masahiro Watanabe at the University of Alberta and under the supervision of Valerie Ramey at the University of California, San Diego.

The research project in Chapter 3 was identified, designed and executed by the author under the supervision of Akiko Watanabe and Masahiro Watanabe at the University of Alberta.

The research project in Chapter 4 was identified by the author. I designed the methodology with my coauthors Akiko Watanabe and Masahiro Watanabe at the University of Alberta. Significant portion of the empirical analysis was performed by the author. The manuscript was written by the author in collaboration with Akiko Watanabe and Masahiro Watanabe.

Dedication

To my father and my mother

Acknowledgments

I am deeply grateful to my advisors Masahiro Watanabe and Akiko Watanabe for their guidance and support. It has been an honor being their student. I thank you for encouraging and inspiring me to grow as researcher.

I am very grateful to Valerie Ramey for advising me during my visit to the University of California, San Diego. I am also grateful to Aditya Kaul, Felipe Aguerrevere, and Vikas Mehrotra for their continuous guidance. I am thankful to the Alberta School of Business faculty at the University of Alberta for their valuable suggestions.

I would like to thank my colleagues and in particular Parianen Veeren, Ahmad Al-Haji, and Chong Meng for the stimulating discussions. I am grateful to the financial support provided by Alberta Investment Management Corporation and the University of Alberta.

I would like to thank my father and my mother for their words of wisdom, encouragement, and support in all my pursuits. I would like to thank my brother and my sister for their constant support. I am very thankful to both my late grandmothers for encouraging my thirst for knowledge.

Finally, I would like to thank my wife for her infinite support, patience, encouragement, and love, and my baby daughter for being simply amazing.

Table of Contents

List of Tables

List of Figures

CHAPTER 1

Introduction

In order to value an asset, investors account for the delay and the risk of its cashflows. The correction for risk is the more import, and also the more challenging and interesting determinant of the asset value. The risk correction to asset prices is driven by the covariance of asset payoffs with household's marginal utility of wealth. In this essay, I show that news shocks to government spending, trade induced productivity change, and investment-specific technological innovations have a direct effect on the household's marginal utility and examine how these shocks affect the cross section of firms.

In Chapter 2 , I examine how news shocks regarding future government spending affect asset prices and study their macroeconomic dynamics. I introduce a novel exogenous measure of news shocks to government spending that is available at a higher frequency, thus appropriate for asset pricing. The novel measure has a correlation of approximately 0.58 with one quarter ahead change in per capita real government spending. Asset pricing tests show that stocks with high sensitivity to government spending shocks earn significantly higher expected returns since they deliver high returns when marginal value of consumption is low for the investors. The quarterly return on the long-short portfolio quintiles sorted on the exposure to the government spending shock is approximately 1.67 percent. The empirical evidence is consistent with government spending shocks causing contemporaneously low marginal wealth states. I also find that growth firms, firms that derive most their value from growth opportunities, have lower sensitivity to the government spending shock, compared to value firms, firms that derive most of their value of assets in place. Thus I am able to provide a risk based justification for the well documented value premium puzzle. I formalize the key empirical findings in a two-sector real business cycle model.

In Chapter 3 , I examine how trade induced productivity change affect asset prices and study their macroeconomic dynamics. Difficulty in identifying a valid instrument for exporting has limited researchers the capability to quantify the implications relating firm access to foreign markets. I show that financial data can be used to measure trade induced productivity change. The sizable innovations in the novel measure capture trade negotiations such as the discussions that lead to the *North American Free Trade Agreement* (NAFTA), which reduced trade barriers and costs for many firms in the tradable goods sector. Asset pricing tests show that trade induced productivity shocks carry a robust negative risk premium. Assets with high sensitivity to the trade induced productivity shock have lower returns since they deliver high returns when consumption is dear for investors. The annualized return for the long-short portfolio deciles sorted on the exposure to the trade induced productivity shock is approximately -6.7 percent. I find that the negative risk premium is stronger within larger firms and high investment firms relative to smaller firms and low investment firms. I present a simple two-sector real business cycle model that formalizes the intuition and details the mechanism through which trade induced productivity shocks impact asset returns.

Chapter 4 examines the pricing of investment-specific technological (IST) innovations in a large cross section of stocks from 33 countries. IST shocks are technological innovations which affect consumption only through the formation of new capital stock.

Although real investment affects the households' marginal utility of consumption, and hence their pricing of claims to the firms' cashflows, researchers debate on the implied pricing relation. We examine the pricing of IST innovations by expanding the cross section of economies to seek heterogeneity in economic stages. We find a spectrum of risk premiums ranging in both magnitude and sign, with more prevalence on the negative side. We focus on identifying the determinants of the IST-shock pricing, especially between the developed and emerging economies. We document that access to capital, access to financial institutions, and product market competition are the three main drivers of IST-shock pricing. We also find that the IST effect is associated with, but not subsumed in, the global value effect.

CHAPTER 2

Government Spending Shocks and Asset Prices

2.1. Introduction

The global financial crisis, the European debt crisis and the recent presidential election have ignited a passionate debate on the effects of government spending, and in particular, the implications of fiscal stimulus packages. Although there is substantial macroeconomic literature that analyses the implications of government spending on the economy, literature remains divided on key issues. Difficulty in identifying an exogenous measure of unanticipated government spending shocks remains the primary challenge limiting the progress on this subject. Endogeneity and predictability eliminate the application of innovations to real government spending as an approximation of fiscal shocks. In addition, there is a paucity of research that examines the effects of government spending shocks on asset returns. The focus of this paper is to fill this gap in the literature.

The goal of this paper is to analyze the implications of government spending shocks on asset prices and study their macroeconomic dynamics.[1] The proposed measure is the returns to the portfolio long firms that contribute most of their final value to the government sector (henceforth, *GOVT* sector) minus firms that contribute most of their final value to the private sector (henceforth, *PRIV* sector), the returns to the *GMP* portfolio. Given that defense spending is the most plausible exogenous

[1]This article refers to news shocks to government spending as government spending shocks for convenience.

portion of the government spending, I restrict the *GOVT* sector to industries with a *defence* focus. Changes to non-defence spending such as education and infrastructure spending are partly in response to economic conditions.[2] In addition, majority of the discretionary government spending is allocated to defence related expenditure. For example, in 2015, approximately 53.7 percent of the $1.11 trillion dollars of the discretionary spending was allocated towards military expenditure.[3] This implies that variations in defence spending represent important deviations in exogenous fiscal policy decisions. In addition, I restrict the *PRIV* sector to industries that contribute most of their output to household consumption to eliminate the possibility of the novel measure capturing investment-specific and trade-induced technological change.

The *GMP* portfolio returns coincide with major defence news events published in news sources such as the Businessweek and the New York Times. Asset pricing tests show that government spending shocks carry a positive risk premium. The annualized return on long-short portfolio deciles sorted on the exposure to the spending shock is approximately 6.7 percent for post-WWII time period. The cross sectional factor premium for the *GMP* return spread is approximately 9.1 percent controlling for Carhart (1997) four factors. The positive risk premium is consistent with government spending shocks causing low marginal utility states in the short-run. Assets with high exposure to the government spending shock are riskier to hold since they appreciate during low marginal utility states. Investors require compensation for holding

[2] Ramey (2011*a*) points out that some of the non-defence spending such as education expenditure is largely driven by demographic changes in the U.S. Demographic changes have many effects on the economy that are unrelated to government spending shocks. To ensure exogeneity in spending, I restrict *GOVT* to industries that contribute to defence spending.

[3] Discretionary spending refers to the portion of the fiscal budget that is decided by the U.S. Congress through the annual appropriations process each year. Other discretionary spending includes, but not limited to, education (6.3 percent), medicare (5.9 percent), science (3.5 percent), and veteran benefits (5.9 percent).

assets that co-move positively with the spending shock in the form of lower prices, or equivalently, higher expected returns. I show that the risk premium is robust to the inclusion of commonly used risk factors in empirical asset pricing literature such as the Carhart (1997) four factors and the Fama and French (2015) five-factors. I formalize these insights in a two-sector real business cycle (RBC) model subject to government spending shocks, in which consumption and asset prices are endogenously determined.

The fiscal policy literature has emphasized the importance of correct identification of government spending shocks. In this paper, I provide ample evidence that a positive shock to the GMP portfolio returns predicts future per capita real government spending. I find that non-residential investment and, to a lesser extent, durable-consumption increase on impact but decrease in the long run following a positive fiscal shock.[4] The sign of the risk premium is informative as to whether government spending shocks cause contemporaneously high or low marginal utility states. The positive premium is consistent with government spending shocks causing contemporaneously low marginal utility states. Assets with high exposure to the government spending shock are riskier to hold as such assets appreciate during low marginal utility states. Investors require compensation for holding assets that co-move positively with the government spending shock in the form of lower prices, or equivalently, higher expected returns. The positive risk premium is robust to the inclusion of commonly used risk factors in asset pricing such as the Fama and French (1993) three factors

[4] The increase in consumption is mostly driven by the durable goods portion of consumption. All forms of consumption decrease in the long run. The temporary increase in consumption disappears for the post 1980 sample.

and the Carhart (1997) four factors. In addition, the positive risk premium is robust across a variety of test assets including the commonly used portfolios sorted on book-to-market equity and size.

I find that government spending shocks amplify the value premium, the cross sectional property where value firms outperform growth firms. Value firms, which derive most of their value from assets in place, have higher sensitivity to the spending shock in comparison to growth firms, which derive most their value from growth opportunities.[5] An increase in future tax liabilities has a greater impact on cash-flows than on growth opportunities, hence value firms are more exposed to cash-flow risk arising from spending shocks compared to growth firms.[6] Growth firm profits accrue much further in the future, thus have lower expose to cash-flow risk arising from spending shocks. I show that the returns on value firms significantly increase, whereas the returns on growth firms remain unaffected by the spending shock. Despite earning lower average returns, households are willing to hold growth stocks since they have lower exposure to cash-flow risk arising from spending shocks.[7] I show that controlling for the exposure to the government spending shock significantly weakens the value premium for the post-WWII time period.

I formalize the main empirical findings in a two sector general equilibrium model. Specifically, the purpose of the model is threefold. Firstly, I show that a positive government spending shock causes a low marginal wealth state in the short run. The

[5]It is well known that value firms consistently deliver higher returns than growth firms (see, for e.g., Fama and French (1992), and Fama and French (1993)). The capital asset pricing model's (CAPM) failure to explain this phenomenon makes the value premium a puzzle.

[6]I build on Campbell and Vuolteenaho (2004) and Lettau and Wachter (2007) intuition which shows that value firms co-vary more with the aggregate cash-flows compared to growth firms.

[7]It is possible that other sources of systematic risk also amplify the value premium. For example, Papanikolaou (2011) finds that investment-specific technological shocks contribute to the value premium.

combination of correlated news shocks to government consumption and government investment, and distortionary taxes generate the temporary low marginal wealth state that is observed in data. The model generates a long term decrease in consumption observed in data, consistent with the neoclassical literature. Secondly, I show that the return spread between the $GOVT$ sector and the $PRIV$ sector perfectly captures news shocks to government spending, formalizing the novel measure. Finally, I show that a positive news shock to government spending decreases the Tobin's marginal q, the marginal value of an additional unit of investment to their replacement cost, in the $PRIV$ sector.

In addition to the novel asset pricing insights, this paper contributes to the current fiscal stimulus debate, which has shifted much of the focus in macroeconomics back to the empirical estimates of government spending multipliers, the ratio of the change in output to the change in government spending. Ramey (2011*b*) surveys recent literature and finds that reasonable estimates of the government spending multipliers range from 0.8 to 1.5, although estimates could be as low as 0.5 or as high as 2.0. Using the GMP portfolio returns to approximate government spending shocks, I show that the estimated output multiplier is 0.85, evaluated after two years.[8]

The rest of the paper is organized as follows. In section 2.2 , I review the related literature. Section 2.3 discusses data and introduces the new measure of government spending shocks. Section 2.4 discusses the methodology and macroeconomic dynamics. Section 2.5 quantifies the risk premium associated with the government spending shock. Section 2.6 introduces the two sector general equilibrium model with government spending shocks. The section 2.7 concludes.

[8]I estimate the government spending multiplier as the integral of output response divided by the integral of government spending response.

2.2. Background and Related Literature

This paper contributes to the empirical literature that examines the effects of government spending on investment and asset returns. Using the proportion of each industry's total output that is purchased by the government sector as a measure of sensitivity to fiscal policy, Belo, Gala, and Li (2013) find significant industry variation in average returns conditional on the presidential partisan cycle. In contrast, by creating a time series aggregate measure, I show that the expected stock returns are linear in asset betas with respect to unanticipated government spending shocks. Using seasonally adjusted nondefense government gross investment as a measure, Belo and Yu (2013) find that government investment in the public sector forecasts high risk premiums both at the aggregate and firm-level. I show that the returns to the GMP portfolio significantly forecast future change in real government investment and government consumption.

In addition, this paper contributes to the theoretical literature examining the association between government policies, economic activity, and asset prices. The paper Croce, Kung, Nguyen, and Schmid (2012) propose a production based model subject to government expenditure shocks that generate tax risk through the government's budget constraint. The authors find that tax distortions have negative effects on the cost of equity and investment. Gomes, Michaelides, and Polkovnichenko (2013) consider an overlapping generations model with incomplete markets and heterogeneous agents, where government debt and capital are imperfect substitutes. The authors find that an increase in government debt increases the riskless rate and decreases the equity premium. Bretscher, Hsu, and Tamoni (2016) estimate a New-Keynesian model to explore the impact of level and volatility shocks to government spending on the term structure of interest rates and bond risk premia, whereas my real business cycle (RBC) model explores the implications of news shocks to government spending on equity returns. Pastor and Veronesi (2012) analyze the effects of political uncertainty and impact uncertainty on stock prices, in a theoretical setting, whereas this study focuses on the effects of exogenous government spending shocks on asset returns, with perfect information.[9]

In addition to the contribution to asset pricing literature, this article advances the empirical fiscal policy literature, which remains divided on key issues. Several strands of literature assume that government spending is predetermined within the quarter (Rotemberg and Woodford (1992); Blanchard and Perotti (2002)). Such literature finds that a positive government spending shock increases output, hours, real wages, productivity and consumption, consistent with the New Keynesian theory. Literature using Ramey and Shapiro (1998) "war dates" finds that fiscal shocks increase output and hours while decreasing real wages, consistent with the neoclassical theory (Ramey and Shapiro (1998); Edelberg, Eichenbaum, and Fisher (1999); Burnside, Eichenbaum, and Fisher (2004)). The key difference between the predetermined VAR approach and the "war dates" narrative approach is in the timing of the shocks (Ramey (2011*a*)); defence news shocks Granger-cause VAR shocks, which suggests that the "war dates" narrative accounts for anticipation effects. However, the defence news narrative is less suitable for asset pricing given that the measure is available at a low frequency and has lower predictive power in the post-Korean war sample. The novel measure proposed in this paper is available at a higher frequency and has predictive power in the post-Korean war sample. Mountford and

[9]Pastor and Veronesi refer to political uncertainty as uncertainty about the change in current government policy and impact uncertainty as uncertainty regarding the impact of new government policy on the profitability of the private sector.

Uhlig (2009) use sign restrictions on a VAR system and find that an increase in government spending increases output and decreases real wages and investment, more in accordance with the Neoclassical theory than the new Keynesian theory. Fisher and Peters (2010) use innovations in average excess returns of the top defence contractors to approximate government spending shocks. However, this measure suffers from using a limited number of stocks in the mimicking portfolio, which limits the diversification of firm level idiosyncratic risk unrelated to defence spending. In addition, the expected returns of the top defence contractors are exposed to other forms of macroeconomic risk unrelated to fiscal shocks such as investment-specific technological shocks and trade induced productivity shocks. The novel measure proposed in this paper redress the concerns in the Fisher and Peters measure.

Finally, my paper contributes to the theoretical literature that examines the effects of government spending on economic activity. Real business cycle models predict that an increase in government spending increases labor hours and output, and decreases real wages and consumption (Aiyagari, Christiano, and Eichenbaum (1992); Baxter and King (1993)). In contrast, the New Keynesian models which include either labor market rigidities or rule-of-thumb consumers predict that an increase in government spending leads to an increase in consumption, labor hours, real wages and productivity (Rotemberg and Woodford (1992); Devereux, Head, and Lapham (1996); Gali, Lopez-Salido, and Valles (2007)). By i) introducing correlated news shocks to government consumption and government investment, and ii) incorporating distortionary taxes, I show that a positive government spending shock causes a low marginal utility state in the short run whereas high marginal utility states in the long term.

2.3. Empirical Evidence

Firms that contribute most of their final output to the government sector appreciate in value following a government spending shock (Fisher and Peters (2010)). Military contractors such as Lockheed Martin Corporation and General Dynamics Corporation benefit from an exogenous increase in government spending relative to firms producing household consumption goods. Thus, I employ the return spread between the $GOVT$ sector and the $PRIV$ sector to approximate unanticipated shocks to government spending. I construct the novel measure using both macroeconomic and financial data.

2.3.1. Data

Firm Level Data. The stock return data is from New York Stock Exchange (NYSE), American Stock Exchange (AMEX) and NASDAQ obtained from the Center for Research in Security Prices (CRSP) at the University of Chicago. The quarterly returns are computed using compounded monthly returns. Following Fama and French (1992), I exclude all financial firms from the sample given the unusually high leverage. In addition, I eschew financial firms from the sample to eliminate the novel measure from capturing news relating to bailouts in the financial sector.[10]

The accounting data is from the COMPUSTAT database. I use screening to satisfy the standard requirements in finance literature. A firm must have a December fiscal-year end and at least two years of data to be included in the sample. The sample includes data from July 1963 to December 2014.

[10]Most financial bailouts are in reponse to business cycle conditions, thus mostly endogenous.

The market value of equity (ME) of a firm, the stock price times the number of shares outstanding, is computed using CRSP data each year at the end of June. Following Fama and French (1993), the book value of equity (BE) of a firm is computed as the COMPUSTAT book value of stockholder's equity plus balance sheet deferred taxes and investment tax credits minus the book value of preferred stock. Depending on the availability of data, redemption, liquidation, or par value is used to estimate the book value of preferred stock. The book-to-market equity (BE/ME) of a firm is the book equity for the fiscal year ending in calendar year $t-1$ divided by the market equity at the end of December of $t-1$. Negative and zero book values are treated as missing.

GMP Portfolio Returns. Following Gomes, Kogan, and Yogo (2009) and Papanikolaou (2011), I use the U.S. Department of Commerce's National Income and Product Accounts (NIPA) input-output tables to classify industries into $PRIV$ sector, industries producing goods mostly for private consumption, and $GOVT$ sector, industries producing goods mostly for government consumption, based on the characteristic of their output.[11] I use input-output tables which includes over 370 NAICS industries. To eliminate endogeneity concerns, I restrict the $GOVT$ sector to industries with a defence focus.[12] I require a minimum five defence firms in a month to be included in the sample. The time series average of the number firms in the $PRIV$ sector and the $GOVT$ sector are 1035.1 firms and 23.9 firms, respectively, for the post-WWII time period.[13]

[11]I include both direct and indirect government expenditures as total government expenditures.

[12]Fisher and Peters (2010) clearly show that a large portion of Boeing's sales are from commercial aircraft sales. I find that the results are robust to excluding Boeing from the GMP measure. The time-series of the GMP return spread excluding Boeing is available upon request.

[13]The limited number of stocks in the $GOVT$ sector in the earlier part of the time series limits the diversification of firm level idiosyncratic risk unrelated to defence spending. Thus, I carry out a

I construct the value-weighted portfolio long *GOVT* sector minus *PRIV* sector firms, the *GMP* portfolio returns, to approximate news shocks to government spending. Table 2.1 shows the portfolio composition of the two sectors of the economy. Although the *PRIV* sector is significantly larger in comparison to the *GOVT* sector, the *PRIV* and *GOVT* portfolios have similar fundamental characteristics; both portfolios have similar BE/ME ratios, market equity, debt-to-assets ratios, cash flows-to-assets ratios, investment-to-assets ratios and gross profitability.

Figure 2.1 presents the time-series of the *GMP* returns from July 1947 to December 2016. Many of the positive shocks to the *GMP* portfolio spread coincide with *Businessweek* and *New York Times* news articles related to defence spending. For example, the positive shock to *GMP* returns in the third quarter of 1965 and the consistently high returns from the fourth quarter of 1966 to the second quarter of 1967 coincide with news regarding large increases in defence spending related to the Vietnam War. The high returns in 1974 coincide with the events surrounding the Arab–Israeli war and the consecutive high returns in 2002 coincide with the increases in defence spending following 9/11 terrorist attacks.

The figure also shows the NBER recessions. The dotted lines present the beginning and end of each recession since 1947. The recessions have an inconsequential effect on government spending shocks. The annualized average of the time-series is approximately 3.7 percent for the post WWII time period.

number of tests to validate that the returns to the *GMP* portfolio mostly capture news shocks to government spending.

2.4. New Measure of Government Spending Shocks

In order to validate the new measure, I study its macroeconomic dynamics. Specifically, I estimate the following vector Autoregressions (VAR),

$$X_t = A(L)X_{t-1} + \epsilon_t, \tag{2.1}$$

where X_t is a vector of variables, $A(L)$ is a polynomial in the lag operator and ϵ_t is a vector with white-noise disturbances that may be correlated. Following Ramey (2011a), I include four lags of each variable, and a quadratic time trend. I use quarterly data instead of annual data for better accuracy. Macroeconomic variables are from the U.S. Bureau of Economic Analysis (BEA). Following recent fiscal policy literature (e.g., Burnside, Eichenbaum, and Fisher (2004) and Ramey (2011a)), I use a fixed set of variables and rotate additional variables of interest, one at a time. The fixed set of variables consists of returns to the GMP portfolio, log of real per capita government spending, log of real per capita GDP, three-month T-bill rate, log of per capita labor hours, the Barro and Redlick (2011) average marginal income tax rate and the Pastor and Stambaugh (2003) market liquidity measure.[14] The extra variables considered are the business wage, the log of real per capita non-residential and residential investment, the log of real per capita non-durable, durable and service consumption and the Ramey *defence news measure*.

Figure 2.2 presents the orthogonalized impulse responses to a positive government spending shock. The responses are normalized such that the maximum response of

[14]The average marginal tax rate is available until end of 2008, limiting the time series from 1963 to 2008 for the VAR analysis.

real government spending is equal to one. I include the conventional 95 percent bootstrapped standard error bands.[15] Both defence spending and government spending peak nine quarters following a positive shock to the *GMP* returns. The increase in government spending becomes significant in the seventh quarter; hence the *GMP* returns capture news shocks consisting of the anticipation effect.

The non-durable plus services consumption significantly increases in the short-run. In addition, residential investment, which consists of new construction of permanent single-family and multi-family housing, and improvements to housing units, rises in the short-run. Taken together, the results imply that the household's experience a decrease in the marginal utility, and command a positive risk premium to hold assets which co-vary with the spending shock.

The long-run effects are strikingly different to that of the short-run implications. Real wage decreases significantly from the third quarter onwards. Residential investment and non-durable consumption decrease in the long-run. Taken together, the results imply that the household's experience a negative wealth effect in the long-run, consistent with the neoclassical literature.

Pastor and Veronesi (2012) theoretically show that policy uncertainty is reflected in stock returns. To examine whether *GMP* returns capture economic policy uncertainty (EPU) in addition to spending shocks, I explore the response of Baker, Bloom, and Davis (2016) long-span EPU index based on historical archives of the *Wall Street Journal*, *New York Times, Los Angeles Times, Boston Globe, Chicago Tribune*, and *Washington Post.* A decrease in EPU implies that the *GMP* measure captures news shocks which provide investors information that reduces uncertainty. The response

[15]Previous fiscal policy literature has appealed to Sims and Zha (1999) for using the 68 percent confidence bands. However, given the high predictive power of the *GMP* portfolio returns, I include 95 percent confidence bands.

of the EPU index decreases significantly at the conventional 95 significant level, implying that *GMP* returns mostly capture news shocks to government spending which reduces the economic policy uncertainty.

It is theoretically possibile that the returns to the GMP portfolio capture TFP shocks in the $GOVT$ sector. To examine this possibility, I explore the response of industry level TFP in the $GOVT$ sector using local projections. Specifically, I estimate,

$$x_{i,t+k} - x_{i,t-1} = \alpha_i + \gamma_{gmp}\ r_t^{GMP} + \gamma_{mkt}\ (\ r_t^{MKT} - r_t^f) + \epsilon_{i,t}, \tag{2.2}$$

where i denotes the industry, x denotes the log value of the predicted variable, r_t^{GMP} denotes the return spread between $GOVT$ and $PRIV$ good producers, and r_t^{MKT} is the returns on the market portfolio. The predicted variables are the 4-factor TFP, including capital (K), production worker hours (N), non-production worker hours (L), and materials (M), as well as the 5-factor TFP, which splits the materials variable into energy (E) and non-energy materials (M-E). The data is from the NBER-CES Manufacturing Industry Database. I use the full available sample from 1958 to 2011.

Figure 2.3 show the local projections from the panel regression 2.2 . There is no immediate increase in the total factor productivity. The response is not significant at the conventional levels. This suggests that the spread in returns capture the government spending shock unrelated to TFP in the $GOVT$ sector.

2.5. Asset Pricing Results

In this section, I examine the asset pricing implications of government spending shocks using portfolio sorting and cross sectional estimations.

2.5.1. Estimation of β^{gmp}

I use stock return betas with respect to the GMP portfolio returns to measure firm level exposure to government spending shocks. Specifically, I estimate the following time series regression for each firm at each quarter using the previous 60 months of data,

$$r_i - r_{f,t} = \alpha_{i,t} + \beta_{i,t}^{mkt} r_t^{mkt} + \beta_{i,t}^{gmp} r_t^{gmp} + \epsilon_{i,t}, \tag{2.3}$$

where $t = 1, \ldots, 60$, r_i is the monthly stock return for firm i, r^{mkt} is the excess market portfolio returns, and r^{gmp} is the GMP portfolio returns. The returns to the market portfolio controls for other forms of systematic risk. The parameter β^{gmp} is the measure of firm exposure to the government spending shock.

2.5.2. Portfolio Sorting

To study the risk premium, I sort firms into 10 portfolios (deciles) by their exposure to the spending shock. I exclude $GOVT$ firms to avoid picking up any mechanical association. I also restrict the analysis to stocks with ordinary common equity. In June of each year, I rank all NYSE, AMEX, and NASDAQ stocks by their pre-ranked β^{gmp} and allocate them to the GMP portfolio decile.

Table 2.2 shows the summary statistics of the value-weighted excess returns and the firm characteristics of the GMP portfolio deciles. I report the results for both the post WWII (full sample) and the post NASDAQ time periods. I also report the monthly excess returns over the capital asset pricing model (α_{CAPM}), and monthly excess returns over the Fama and French (1993) three-factor model ($\alpha_{3-Factor}$). The t-statistics are reported in brackets using Newey and West (1987) standard errors, allowing for six lags.

The average firm's pre-ranked β^{gmp} ranges from -0.64 to 1.00, capturing a sizable variation in the sensitivity to spending shocks.[16] The excess returns monotonically increase as the exposure to the government spending shock increases for the full sample. The annualized value-weighted long-short portfolio spread (H-L) is 6.74 percent and 8.22 percent, for the full sample and the the post NASDAQ sample, respectively. The long-short return spreads are statistically significant at the conventional levels for both samples. The results imply that households experience a short-run decrease in marginal utility following the spending shock.

The traditional capital asset pricing model (CAPM) predicts that stocks with higher exposure to systematic risk, captured by the sensitivity to the market portfolio (β^{MKT}), have higher expected returns. The results show that the portfolios display a U-shaped pattern with respect to β^{MKT}, which is inconsistent with the predictions of the CAPM. In addition, the α_{CAPM} is positive and significant for both samples, hence the CAPM fails to explain the deciles sorted by the exposure to the spending shock.

The $\alpha_{3-Factor}$ is positive and significant at the 10 percent and the 5 percent level, for the post WWII sample and the post NASDAQ sample, respectively. Thus, the Fama and French (1993) three-factor model fails to fully capture systematic risk associated with the spending shock.

[16] Small variation in betas leads to erroneous factor premiums.

2.5.3. Value versus Growth

The β^{gmp} portfolio deciles show a positive association between the BE/ME ratio and the sensitivity to the spending shock, although the association is not monotonic. Here, I explore this association further. Literature documents that value stocks have a higher co-movement with the aggregate cash-flows compared to growth stocks (Campbell and Vuolteenaho (2004); Lettau and Wachter (2007)) and value stocks are more sensitive to market-wide shocks to cash-flows (Campbell, Polk, and Vuolteenaho (2010)).[17] The increase in future tax liabilities has a larger impact on cash-flows than growth options. The government spending shock increases the cash-flow risk in value firms, thus increasing the expected returns.

Impulse Responses. To explore this association, I examine the response of the value premium approximated by the returns to the Fama and French (1993) *HML* portfolio. The *HML* factor is the difference between the returns on diversified portfolios of high and low BE/ME ratio stocks. In addition, I examine response in the returns of growth firms and value firms separately. I approximate growth stocks using the lowest decile on portfolios sorted on BE/ME ratio. Similarly, to approximate value firms, I use the highest decile on portfolios sorted on BE/ME ratio. To keep consistency with previous literature, I use the HML and BE/ME portfolio deciles from Kenneth R. French's data library. For robustness, I instrument government spending shocks using the *GMP* returns and Ramey (2011*b*) *defence news measure*.

Figure 2.4 presents the responses using the VAR system in 2.1 . The value factor significantly increases to a positive spending shock, whether it is approximated using the *GMP* returns or the *defence news measure*. The returns on the value portfolio

[17]In terms of betas, value stocks have high cash-flow betas compared to growth stocks.

increase significantly at the 5 percent level, whereas the effect is insignificant for the growth portfolio. The results confirm that value stocks become riskier following the spending shock. Growth firms, in contrast, have the option to exercise the projects that appear to be profitable and defer less profitable projects, thus mitigating the risk generated through the spending shock. Despite earning the lower expected returns, investors are willing to hold growth stocks given their lower sensitivity to the government spending shock.

2.5.4. Cross Sectional Tests

The next set of asset pricing tests includes Fama and MacBeth (1973) two-pass regressions. In the first-pass, I estimate the betas ($\beta_{i,t}$) using a 60 month window using the following time series regression,

$$r_{i,t} - r_{f,t} = \alpha_{i,t} + \beta_{i,t} f_{i,t} + \epsilon_{i,t}, \tag{2.4}$$

where r_i is the return on portfolio i, r_f is the risk-free rate, f_i is a vector consisting of pricing factors, $\alpha_{i,t}$ is the conditional constant, and $\beta_{i,t}$ is the conditional beta for portfolio i at time t. In the second-pass, I run a cross sectional regression at each month t,

$$r_i - r_f = \lambda_t \beta_i + e_i, \tag{2.5}$$

where λ_t is the conditional factor premium at time t. Finally, I average the estimated $\widehat{\lambda}_t$ over time to estimate the factor premium,

$$\widehat{\lambda} = \frac{1}{T} \sum \widehat{\lambda}_t. \tag{2.6}$$

I use 75 portfolios as test assets to estimate the risk premiums. The test assets include 25 portfolios sorted on BE/ME ratio and size, 25 portfolios sorted on β^{gmp} and size, and 25 portfolios sorted on β^{MKT} and size. The standard errors are adjusted using Newey and West (1987) corrections using 3 lags. In addition, I report the time series average R^2 from the cross sectional regressions. The sample is from July 1947 to December 2016.

Table **??** presents the estimated factor premiums from the second pass regressions. Column (I) shows the results for the CAPM. The factor premium on the excess market portfolio is insignificant. In column (II), I include the *GMP* returns as a factor. The risk premium associated with the spending shock is positive and statistically significant, consistent with the portfolio sorting results.

In column (III), I present the Fama and French (1993) three-factor model. Only the value factor is significantly priced in the cross section. The annualized return on the value factor is approximately 3.8 percent for the sample period. In column (IV), I include the *GMP* returns as a factor in addition to the Fama and French three factors. I find that the government spending shock is priced in the cross section along with the value premium. This shows that government spending shocks only amplify the value premium, and that the spending shock does not subsume the value effect.

Column (V) shows the Carhart (1997) four-factor model. Similar to (III), only the value factor is significantly priced in the cross section of the test assets. In Column (VI), I include the *GMP* returns in addition to the four factors and find that the spending shock is significantly priced in the cross section. The annualized return on the government spending shock is approximately 9.1 percent for the sample period, which is approximately twice the magnitude of the value premium.

Column (VII) shows the Fama and French (2015) five-factor model. Given the availability of RMW and CMA factors, I restrict the analysis to the post-Compustat time period. The value factor and the investment factor are significantly priced in the cross section. Column ($VIII$) includes the *GMP* returns in addition to the five factors. The spending shock is significantly priced in the cross section in addition to the value and investment factors.

In all the specifications, the risk premium on the *GMP* portfolio is positive and statistically significant. The results underscore the importance of spending shocks in pricing the cross section of asset returns.

The next set of tests employs the one-step Generalized Method of Moments (GMM) procedure as described in Cochrane (2005). Here, the moment conditions simultaneously include the time-series orthogonality conditions and the cross-sectional orthogonality conditions.[18] Table 2.4 reports the risk premia using the identity weighting matrix. I also report the mean absolute pricing errors (MAPE), the J-test of the overidentifying restrictions of the model and corresponding p-values. The standard errors are adjusted using Newey and West (1987) corrections using lags up to one year. For robustness, I use the more conventional 25 portfolios sorted on size and book-to-market equity.[19] Also, for additional validity, I use the Ramey $defence\ news\ measure$, $Defence$, to approximate government spending shocks. I apply the innovations to utilization-adjusted Total Factor Productivity, TFP, to control market wide total factor productivity shocks.[20]

[18]The time-series orthogonality conditions are estimated without an intercept.

[19]The 25 portfolios sorted on size and book-to-market equity are from Kenneth French's web site.

[20]The utilization adjusted TFP is from the Federal Reserve Bank of San Francisco (John G. Fernald 2012).

The first three specifications show that the risk premium for the GMP returns is positive and significant for the time period from 1963 to 2014. The next three specifications show that the risk premium for the $defence\ news\ measure$ is positive and significant for the time period from 1939 to 2014. The positive and significant risk premium in all of the cross sectional tests provide further evidence that government spending shocks cause contemporaneously low marginal utility states.

2.6. Real Business Cycle Model

The empirical analysis established three key facts. Firstly, the return spread between the $GOVT$ sector minus the $PRIV$ sector approximates news shocks to government spending. Secondly, the unanticipated fiscal spending shocks lead to contemporaneously low marginal utility states. Thirdly, government spending shocks inhibit the value of growth opportunities. In this section, I develop a two-sector RBC model to organize the key empirical findings. I extend the Baxter and King (1993) neoclassical model by introducing an additional private sector that benefits from government spending. In addition, I employ distortionary taxes which finances government spending. The aforementioned extensions generate the consumption dynamics observed in data. Finally, I extend the neoclassical model by introducing asset prices.

2.6.1. Households

The economy is populated by identical agents who maximize their lifetime utility, U, defined over sequences of consumption, C_t, and hours worked, N_t. I employ Jaimovich and Rebelo (2009) preferences which nest King, Plosser, and Rebelo (1988) preferences ($\gamma = 1$) and Greenwood, Hercowitz, and Huffman (1988) preferences ($\gamma = 0$) where the wealth effect on labor supply is scaled using lower values of γ. The extreme case in which $\gamma = 0$ completely shuts off the wealth effect on labor supply. Agents internalize the dynamics of X_t, which is a a geometric average of current and past habit-adjusted consumption levels, in their maximization problem. The use of X_t makes preferences non time separable in consumption and hours worked. The preferences are expressed as

$$U = \mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t \frac{\left(C_t - hC_{t-1} - \psi N_t^{\theta} X_t\right)^{1-\sigma} - 1}{1-\sigma}, \tag{2.7}$$

where

$$X_t = \left(C_t - hC_{t-1}\right)^{\gamma} X_{t-1}^{1-\gamma}, \tag{2.8}$$

and $\mathbb{E}_0$ denotes the expectation operator conditional on information at time zero, the parameter $\beta \in (0,1)$ denotes the subjective discount factor, $\theta > 1$ determines the Frisch elasticity of labor supply, $\psi > 1$, and $\sigma > 0$. Literature has shown that habit formation models are successful at explaining both asset pricing and macroeconomic phenomena observed in data (see, for e.g., Constantinides (1990); Campbell and Cochrane (1999), Abel (1990); Boldrin, Christiano, and Fisher (2001); Schmitt-Grohe and Uribe (2012)). I extend Jaimovich and Rebelo framework by including habit persistence; the parameter $h \in [0,1)$ governs the degree of internal habit formation. The economy wide resource constraint is given by

$$Y_t = \underbrace{C_t}_{\text{consumption}} + \underbrace{\frac{I_{1,t}}{Z_t} + \frac{I_{2,t}}{Z_t}}_{\text{private investment}} + \underbrace{I_{G,t} + C_{G,t}}_{\text{government spending}}, \tag{2.9}$$

where I_1 and I_2 are the investment in sector 1 and sector 2 of the economy, Z denotes the current state of technology for producing capital goods, I_G and C_G are government investment and government consumption, respectively. The investment specific technology evolves according to

$$\ln(Z)_{t+1} = \rho^Z \ \ln(Z)_t + \sigma_{\epsilon^Z} \ \epsilon^Z_{t+1}, \tag{2.10}$$

where $\sigma_{\epsilon^Z} \ \epsilon^Z_t$ is an i.i.d. process with standard deviation σ_{ϵ^Z} and $\rho^Z < 1$ such that the process $\ln(Z)$ is stationary.

2.6.2. Firms and Technology

The production of goods and services takes place in two separate sectors. $PRIV$ sector produces goods and services mostly for household consumption while $GOVT$ sector produces goods and services mostly for government consumption. Both sectors of the economy are populated by private sector firms. For simplicity, government owned public firms are excluded from the model. Lockheed Martin Corporation (NYSE: LMT) and General Dynamics Corporation (NYSE: GD), both traded in the New York Stock Exchange, are examples of private sector firms that contribute most their final value to the government sector. Wal-Mart Stores (NYSE: WMT), traded in the New York Stock Exchange, is an example of a private sector firm that contributes most its final value to the private sector consumption.

2.6.2.1. PRIV sector. The $PRIV$ sector firms produce output Y_1 according to the following Cobb-Douglas production function,

$$Y_{1,t} = A_{1,t} N_{1,t}^{\alpha_1} K_{1,t}^{\alpha_{k1}}, \tag{2.11}$$

where A_1 is the total factor productivity (TFP) in the $PRIV$ sector, K_1 is the capital in the $PRIV$ sector and N_1 is the labor supply in the $PRIV$ sector. I assume that $0 < \alpha_1, \alpha_{k1} < 1$ and $\alpha_1 + \alpha_{k1} = 1$.

The after tax dividend stream for the $PRIV$ sector is

$$\Pi_{1,t} = (1 - \tau_t)\, A_{1,t} N_{1,t}^{\alpha_1} K_{1,t}^{1-\alpha_1} - w_t N_{1,t} - \frac{I_{1,t}}{Z_t}, \tag{2.12}$$

where w_t is the competitive wage in the economy.[21]

2.6.2.2. GOVT sector. The $GOVT$ sector directly benefits from an increase government spending. Government influences the efficiency and the profitability of the defence industries by setting profit levels on government contracts. Government supports the defence sector through preferential purchasing and through direct subsidy payments. In addition, government invests in infrastructure and research and development activities of corporations, finances the training and development of employees and provide credit guarantees. To capture such contributions by the government, I include public capital in the production of the $GOVT$ sector.[22] The $GOVT$ sector produces output Y_2 according to the following Cobb-Douglas production function,

$$Y_{2,t} = A_{2,t} N_{2,t}^{\alpha_2} K_{2,t}^{\alpha_{k2}} K_{G,t}^{\alpha_{g2}}, \tag{2.13}$$

where A_2 is the TFP in $GOVT$ sector, K_2 is the capital in $GOVT$ sector, N_2 is the labor in $GOVT$ sector and K_G is the publicly provided capital stock. I assume that $0 < \alpha_2, \alpha_{k2}, \alpha_g < 1$ and $\alpha_2 + \alpha_k + \alpha_g = 1$.[23]

[21] Firms are all-equity financed in both sectors of the economy.

[22] Literature has used public capital in production. Some examples include Aschauer (1989), Baxter and King (1993), Nadiri and Mamuneas (1994), and Leeper, Walker, and Yang (2010).

[23] This form of production is consistent with Jaimovich and Rebelo (2009)Jaimovich and Rebelo (2009) notation $Y_t = A_t K_t^{\alpha_1} N_t^{\alpha_2} T^{1-\alpha_1-\alpha_2}$,where $\alpha_1 + \alpha_2 < 1$ and T is a firm specific production

The after tax dividend stream for the $GOVT$ sector is

$$\Pi_{2,t} = (1 - \tau_t)\, A_{2,t} N_{2,t}^{\alpha_2} K_{2,t}^{\alpha_k} K_{G,t}^{\alpha_{g2}} - w_t N_{2,t} - \frac{I_{2,t}}{Z_t}. \tag{2.14}$$

The TFP shock in each sector evolves according to the following AR(1) specification,

$$\ln(A_i)_{t+1} = \rho_A^i \;\ln(A_i)_t + \sigma_{\epsilon^{A_i}} \;\epsilon_{t+1}^{A_i}, \tag{2.15}$$

where $\rho_A^i < 1$ such that the process $\ln(A_i)$ is stationary and $\sigma_{\epsilon^{A_i}} \;\epsilon_t^{A_i}$ is an i.i.d. process with standard deviation $\sigma_{\epsilon^{A_i}}$ for sector $i = 1, 2$.

Investment is subject to Christiano, Eichenbaum, and Evans (2005) capital adjustment costs in both sectors of the economy. Adjustment costs to investment provide firms with an incentive to respond immediately to changes in Tobin's marginal q. The capital accumulation in each sector is

$$K_{i,t+1} = I_{i,t} \left[1 - \frac{\phi_i}{2} \left(\frac{I_{i,t}}{I_{i,t-1}} - 1 \right)^2 \right] + (1 - \delta_i)\, K_{i,t}, \tag{2.16}$$

where $\phi_i > 0$ for sector $i = 1, 2$.

factor. Note that the firm has constant returns with respect to all factors but decreasing returns with respect to labor and capital.

2.6.3. Public Finance Rules

The public investment is exogenously determined and is stochastic over time.[24] The public capital stock evolves according to

$$K_{G,t+1} = I_{G,t} + (1 - \upsilon\delta)\, K_{G,t}, \tag{2.17}$$

where $\phi_G > 0$, I_G is government investment, υ is a multiplier and δ is capital depreciation rate. The news regarding government investment is known by households before the actual increase and evolves according to the following specification,

$$\ln(I_G)_{t+2} = \rho_1^{gi} \ln(I_G)_{t+1} + \rho_2^{gi} \ln(I_G)_t + \rho_3^{gi} \ln(I_G)_{t-1} + \sigma_{\epsilon^{gi}}\ \epsilon_t^{gi}, \tag{2.18}$$

where $\rho_1^{gi} + \rho_2^{gi} + \rho_3^{gi} < 1$ such that the process $\ln(I_G)$ is stationary and $\sigma_{\epsilon^{gi}}\ \epsilon_t^{gi}$ is an i.i.d. process with standard deviation $\sigma_{\epsilon^{gi}}$.[25] Government consumption is exogenous and is stochastic over time. The news shocks regarding government consumption, gc, evolves according to the following specification,

$$\ln(C_G)_{t+2} = \rho_1^{gc} \ln(C_G)_{t+1} + \rho_2^{gc} \ln(C_G)_t + \rho_3^{gc} \ln(C_G)_{t-1} + \sigma_{\epsilon^{C_G}}\ \epsilon_t^{gc}, \tag{2.19}$$

where $\rho_1^{gc} + \rho_2^{gc} + \rho_3^{gc} < 1$ such that the process $\ln(gc)$ is stationary and $\sigma_{\epsilon^{gc}}\ \epsilon_t^{gc}$ is an i.i.d. process with standard deviation $\sigma_{\epsilon^{C_G}}$. The term ϵ_t^{gc} captures the unanticipated news regarding government consumption in the economy.

[24] Public capital stock includes publicly provided telecommunications, electricity, roads, railways, ports, airports, public research and development, conservation structures, development structures, military structures etc.

[25] Agents receive information at time $t-1$ regarding the innovation in I_G at time t. Households recieve a signal $S_t = \epsilon_{t+1}^{gi} + \nu_t$, where ν_t is the noise in signal. For simplicity, I do not model noise and interchange $S_t = \epsilon_t$ (see Beaudry and Portier (2014) for a detailed analysis of news shocks).

Empirical data shows a strong positive correlation between government consumption and government investment. During military buildups, government increases both investment and consumption spending; government engages in programs that build roads and airports for military and non-military purposes and increases the purchase of military equipment from the private sector. In order to generate realistic dynamics, I introduce correlated government spending shocks.[26] I assume that $\mathbb{E}_t\left[\epsilon_t^{gi}\right]=0$, $\mathbb{E}_t\left[\epsilon_t^{gc}\right]=0$, and that the contemporaneous variance-covariance matrix of the innovations ϵ_t^{gi} and ϵ_t^{gc} is

$$\begin{pmatrix} \sigma^2_{\epsilon^{gi}} & \rho_{gi,gc}\sigma_{\epsilon^{gi}}\sigma_{\epsilon^{gc}} \\ \rho_{gi,gc}\sigma_{\epsilon^{gi}}\sigma_{\epsilon^{gc}} & \sigma^2_{\epsilon^{gc}} \end{pmatrix}, \tag{2.20}$$

where $corr\left(\epsilon_t^{gi},\epsilon_s^{gc}\right)=0$, $corr\left(\epsilon_t^{gi},\epsilon_s^{gi}\right)=0$ and $corr\left(\epsilon_t^{gc},\epsilon_s^{gc}\right)=0$ for all $t\neq s$. Following Sims (1980), I estimate the triangular matrix to create uncorrelated innovations. The transformed orthogonalized shocks to government investment and government consumption are ν_t^{gi} and ν_t^{gc}, respectively, where $\nu_t=Q\epsilon_t$.

I model the flow of government budget constraint as

$$C_{G,t}+I_{G,t}=\tau_t\left(Y_{1,t}+Y_{2,t}\right), \tag{2.21}$$

where τ is the distortionary income tax rate.

2.6.4. Competitive Equilibrium

The model features five sources of uncertainty: the total factor productivity shocks in each sector, investment-specific technological shocks, shocks to government consumption and government investment. To close the model, aggregate output, capital,

[26]To find the model solution, I use a Cholesky decomposition to orthogonalize the correlated shocks.

investment and labor are defined as

$$Y_t = Y_{1,t} + Y_{2,t}, \;\; K_t = K_{1,t} + K_{2,t}, \; I_t = I_{1,t} + I_{2,t}, \;\; N_t = N_{1,t} + N_{2,t}. \tag{2.22}$$

In this framework, Y_2 enters the household budget constraint to ensure that $GOVT$ sector production is valued by investors. The first order conditions (FOCs) for the economy are defined in the Appendix 1 . I derive the agent's one-period-ahead *stochastic discount factor* (SDF) from the household inter-temporal Euler equation,

(2.23)

$$\mathbb{M}_{t+1} = \beta \frac{\left(V_t^h\right)^{-\sigma} + \mu_{t+1}\gamma\left(\frac{X_t^{1-\gamma}}{C_{t+1}-hC_t}\right)^{1-\gamma} - \beta h \mathbb{E}_{t+1}\left[\left(V_{t+1}^h\right)^{-\sigma} - \mu_{t+2}\gamma\left(\frac{X_{t+1}^{1-\gamma}}{C_{t+2}-hC_{t+1}}\right)^{1-\gamma}\right]}{\left(V_{t-1}^h\right)^{-\sigma} + \mu_t\gamma\left(\frac{X_{t-1}^{1-\gamma}}{C_t-hC_{t-1}}\right)^{1-\gamma} - \beta h \mathbb{E}_t\left[\left(V_t^h\right)^{-\sigma} - \mu_{t+1}\gamma\left(\frac{X_t^{1-\gamma}}{C_{t+1}-hC_t}\right)^{1-\gamma}\right]},$$

where $V_t^h = C_{t+1} - hC_t - \psi N_{t+1}^{\theta} X_{t+1}$, and μ_t is the Lagrange multiplier associated with 2.8 . The risk free rate is $\frac{1}{R_{f,t}} = \mathbb{E}_t\left[\mathbb{M}_{t+1}\right]$.

The $PRIV$ and the $GOVT$ sectors hire labor at the competitive wage rate w_t. The wage rate in the economy is

$$w_t = (1-\tau_t)\,\alpha_1 A_{1,t} N_{1,t}^{\alpha_1} K_{1,t}^{\alpha_{k1}} = (1-\tau_t)\,\alpha_2 A_{2,t} N_{2,t}^{\alpha_2} K_{2,t}^{\alpha_{k2}} K_{G,t}^{\alpha_g}. \tag{2.24}$$ [27]

2.6.5. Asset Prices

In this section, I detail the mechanism through which government spending shocks affect the equilibrium asset returns.

[27] In equilibrium, the marginal product of labor in both sectors are equal, thus $w_{1,t} = w_{2,t} = w_t$.

2.6.5.1. Sectoral stock returns. For each firm in sector i, the value of the firm is the discounted present value of its cashflows, which is,

$$V_{i,t} = \mathbb{E}_t \left[\sum_{j=1}^{\infty} \mathbb{M}_{t+j} \Pi_{i,t+j} \right], \tag{2.25}$$

subject to (9) and (11). In each period, *PRIV* and *GOVT* sector firms choose K and N to maximize their firm value. The gross return on a claim to the cash flows is

$$R_{i,t+1} = \frac{V_{i,t+1} + \Pi_{i,t+1}}{V_{i,t}}. \tag{2.26}$$

2.6.5.2. The Cross Section of Firm Risk Premia. Assume that the projection of the log *SDF*, $m_{t+1} = \ln(\mathbb{M}_{t+1})$, the log of the process in equation 2.23 , spanned by the exogenous shocks in the model is

$$m_{t+1} = \mathbb{E}_t [m_{t+1}] \; - \; \Omega_{t+1}^{A_1} \frac{\epsilon_{t+1}^{A_1}}{\sigma^{A_1}} - \; \Omega_{t+1}^{A_2} \frac{\epsilon_{t+1}^{A_2}}{\sigma^{A_2}} - \; \Omega_{t+1}^{Z} \frac{\epsilon_{t+1}^{Z}}{\sigma^{Z}} - \Omega_{t+1}^{gc} \frac{\nu_{t+1}^{gc}}{\sigma^{gc}} - \Omega_{t+1}^{gi} \frac{\nu_{t+1}^{gi}}{\sigma^{gi}}, \tag{2.27}$$

where $\epsilon_t^{A_1}$, $\epsilon_t^{A_2}$, ϵ_t^{Z}, ν_t^{gc} and ν_t^{gi} are shocks that are orthogonal to each other. The quantities Ω_{t+1}^{i} is the market price of risk (the risk premium per unit volatility, i.e. the Sharpe ratio) for shock i. In order to verify that $\Omega_{t+1}^{i}$is the true market price of risk for each shock, consider a projection of log return of some asset j in the *PRIV* sector, $r_{j,t+1}^{1}$, on the space spanned by the exogenous shocks,

(2.28)

$$r_{j,t+1}^{1} = \mathbb{E}_t \left[r_{j,t+1}^{i} \right] \;\; + \; \beta_{j,t+1}^{A_1} \epsilon_{t+1}^{A_1} \; + \; \beta_{j,t+1}^{A_2} \epsilon_{t+1}^{A_2} + \; \beta_{j,t+1}^{Z} \epsilon_{t+1}^{Z} + \; \beta_{j,t+1}^{gc} \nu_{t+1}^{gc} + \; \beta_{j,t+1}^{gi} \nu_{t+1}^{gi},$$

where $\beta_{j,t+1}^{A_1}$, $\beta_{j,t+1}^{A_2}$, $\beta_{j,t+1}^{Z}$, $\beta_{j,t+1}^{gc}$ and $\beta_{j,t+1}^{gi}$ are factor loadings of the TFP shock in the *PRIV* sector, the TFP shock in the *GOVT* sector, the shock to government consumption and the shock to government investment, respectively. Specifically, I define the exposure as

$$\beta^{i}_{j,t+1} = \frac{cov\left(\epsilon^{i}_{t+1}, r^{1}_{j,t+1}\right)}{\left(\sigma^{i}\right)^{2}}, \tag{2.29}$$

for $i = A_1$, A_2, Z, gc, and I_G. The excess returns for asset j can be expressed as

$$\begin{aligned} \mathbb{E}_t\left[r^{1}_{j,t+1} - r_{f,t+1}\right] + \frac{\sigma_j^2}{2} = -\sigma_{j,m} = \; & \beta^{A_1}_{j,t+1}\sigma^{A_1}\Omega^{A_1}_{t+1} + \beta^{A_2}_{j,t+1}\sigma^{A_2}\Omega^{A_2}_{t+1} + \beta^{Z}_{j,t+1}\sigma^{Z}\Omega^{Z}_{t+1} \\ & + \underbrace{\beta^{gc}_{j,t+1}\sigma^{gc}\Omega^{gc}_{t+1} + \beta^{gi}_{j,t+1}\sigma^{gi}\Omega^{gi}_{t+1}}_{\text{risk premium for government spending shock}}, \end{aligned} \tag{2.30}$$

where σ_j^2 denotes the unconditional variance of log return innovations and $\frac{\sigma_j^2}{2}$ is the Jensen's Inequality adjustment term arising from the use of expectations of log returns.[28] If asset j is perfectly correlated with the government consumption shock, the factor loadings are $\beta^{A_1}_{j,t+1} = 0$, $\beta^{A_2}_{j,t+1} = 0$, $\beta^{Z}_{j,t+1} = 0$, $\beta^{gc}_{j,t+1} = \frac{\sigma_j}{\sigma^{gc}}$ and $\beta^{gi}_{j,t+1} = 0$. Then, the Sharpe ratio for the government consumption shock is

$$\frac{\mathbb{E}_t\left[r^{1}_{j,t+1} - r_{f,t+1}\right] + \frac{\sigma_j^2}{2}}{\sigma_j} = \frac{\beta^{gc}_{j,t+1}\sigma^{gc}\Omega^{gc}_{t+1}}{\beta^{gc}_{j,t+1}\sigma^{gc}} = \Omega^{gc}_{t+1}, \tag{2.31}$$

which verifies that Ω^{gc}_{t+1} in equation 2.27 is the true market price of risk. Similar derivation shows that $\Omega^{A_1}_{t+1}$, $\Omega^{A_2}_{t+1}$, Ω^{Z}_{t+1} and Ω^{gi}_{t+1} are the true market price of risk for each of the shocks. The price of risk for the government spending shock is

$$\Omega^{g}_{t+1} = -\sigma^{g}\frac{\partial m_{t+1}}{\partial \nu^{g}_{t+1}}. \tag{2.32}$$

The equation 2.32 shows that the market price of risk depends on the contemporaneous change in the *SDF* with respect to the change in the government spending shock.

---

[28]The log excess return in (27) is the log counterpart of the standard asset pricing equation, $\mathbb{E}_t\left[R^{1}_{j,t+1}\right] - R_{f,t+1} = -R_{f,t+1}Cov\left(R^{1}_{j,t+1}, M_{t,t+1}\right)$.

The price of risk is positive (negative) if a positive government spending shock causes a contemporaneous decrease (increase) in the *SDF*.

2.6.6. Calibration

I solve the model using second order approximations around the steady state. I calibrate the model using parameters that generate macroeconomic and asset return moments which reasonably match empirical moments.

2.6.6.1. Parameter Choice. Table 2.5 summarizes the parameters used to calibrate the benchmark model at a quarterly frequency. The parameter values are taken from previous literature where possible. Following Papanikolaou (2011), I set the relative risk aversion parameter, σ, to equal 1.1. The recent macroeconomic literature has employed a range of values for θ from 1.4 (Jaimovich and Rebelo (2009)) to 4.7 (Schmitt-Grohe and Uribe (2012)). I use the value $\theta = 2.4$ which helps generate the most realistic response in consumption consistent with the empirical findings. The habit formation parameter is set to $h = 0.32$ to generate a high equity premium volatility.

Following Jaimovich and Rebelo (2009), I set the investment adjustment cost parameter, ϕ, to equal 1.3. Following Baxter and King (1993), I set the quarterly capital depreciation rate to the standard $\delta = 2.5$ percent. I use the value $\upsilon = 5/3$ to better capture forced structure changes, military capital modernizations, and higher R&D depreciation rates. In addition, I use the parameter υ to set the $GOVT$ sector to approximate a quarter of the size of the economy. I choose $\gamma = 0.8$ to generate a high wealth effect on labor supply. The results are robust to the use of $\gamma = 1$, the King, Plosser, and Rebelo (1988) preferences.

I choose $\beta = .99$ such that the first moment of the steady state risk free rate approximates the of the long sample risk free rate in Campbell and Cochrane (1999). On the production side, following Baxter and King (1993), I set the labor share in the $PRIV$ sector, α_1, to equal 0.64, and the capital share to equal 0.36. I assume that the private capital share in both sectors are equal and choose $\alpha_k = (1 - \alpha_1) = 0.36$. Literature has diverse views on the productivity of private investment. The reasonable range of parameter values range from 0.1 (see, for e.g., Baxter and King (1993) and Leeper, Walker, and Yang (2010)) to 0.24 (see, for e.g., Aschauer (1989); Nadiri and Mamuneas (1994)). For simplicity, I set the parameter value of publicly provided capital share to $\alpha_g = 0.15$, which is within the reasonable range.

The volatility of shocks are chosen to match their empirical counterparts in data. The volatilities $\sigma_{\epsilon^{gi}}$ and $\sigma_{\epsilon^{gc}}$ are chosen to match the time series volatility in defence investment and consumption. Following Belo and Yu (2013), I set volatility of the TFP shocks, $\sigma_{\epsilon^{A_i}}$, to 0.86%. For the benchmark calibration, I choose a conservative value of $\sigma_{\epsilon^{Z}} = 1.0\%$ for the volatility of the IST shock.

The firms featured in the model are all equity financed, whereas private firms in the U.S. are financed approximately by 40 percent debt and 60 percent equity. Following Boldrin, Christiano, and Fisher (2001) and Papanikolaou (2011), I multiply stock returns and their standard deviations by a factor equal to 5/3 to better match the moments in data.

2.6.7. Model Implications

Table 2.6 reports the model implied and the empirical moments of the macroeconomic variables. I remove the cyclical component of the empirical time data using the Hodrick–Prescott decomposition. The first two columns report the standard deviations of the change in consumption, investment, labor hours and output for the post World War II time period from 1947 to 2014 and for the post Compustat time period from 1963 to 2014. Columns 3 to 6 report the empirical time series correlation coefficients. The model successfully generates low volatility in the change in labor hours (0.56 percent versus 1.46 percent) and reasonably low volatility in consumption (1.80 percent versus 1.21 percent). The higher volatility in the change in investment is consistent with empirical moments (4.69 percent versus 5.86 percent). The model also generates correlations between the macroeconomic variables similar to that of the correlations observed in data. However, the model underestimates the comovement between consumption and labor hours. This is a result of preferences being close to King, Plosser, and Rebelo (1988) preferences in which high wealth effect limits the response in labor supply following a shock to the TFP in the $PRIV$ sector.

Table 2.7 presents the empirical and model simulated moments for asset returns. The first column shows the empirical moments for the time period from 1963 to 2014 and the second column shows the simulated moments from the model calibration.[29] I calculate the market risk premium in the model as the sum of the value-weighted risk premium for the $PRIV$ sector and the $GOVT$ sector. The model overshoots in terms of the first moment of the risk free rate (2.9 percent versus 4.1 percent) and the volatility of the risk free rate (4.96 percent), higher than the long term average risk free rate volatility of 3.0 percent reported in Campbell and Cochrane (1999). The model is able to generate an annual equity premium of 2.76 percent with a low volatility in consumption and a low risk aversion. As a result of high investment

[29]The risk premium and volatility of the market portfolio is 8.397% and 20.68% for the longer time period from 1927 to 2014.

adjustment costs and internal habit formation in preferences, my model generates a sizable volatility in equity premium similar to the moments is observed in data (16.2 percent versus 18.1 percent).

2.6.8. Model Solution

Figure 2.6 presents the impulse response functions from the simulated model. The responses are normalized such that the maximum response of government spending is equal to one. The actual increase in government spending takes place two periods after the news shock. Thus the model captures the anticipation effect seen in empirical data. Output and investment increase in the $GOVT$ sector and decrease in the $PRIV$ sector following a positive government spending shock. The economy reallocates resources from $PRIV$ sector investment to the more productive $GOVT$ sector investment upon a government spending shock.[30]

2.6.8.1. *Stochastic Discount Factor.* Consumption contemporaneously increases as a result of the temporary increase in wealth resulting from the appreciation in the $GOVT$ sector and the use of distortionary taxes.[31] This differentiates my model from the basic neoclassical framework. In the long run, households decrease consumption as a result of the higher tax liabilities.

The dynamic effects on consumption and labor bundle are reflected in the agent's stochastic discount factor. Figure 2.6 shows that the SDF contemporaneously decreases upon a government spending shock. As shown in (29), the contemporaneous decrease in the SDF corresponds to a positive price of risk for government spending

[30] Note that the GOVT sector is much smaller than the PRIV sector.

[31] In the standard neoclassical model with lump sum taxes (e.g., Baxter and King (1993)), a positive fiscal shock increases the expected taxation by the same present value. The representative household experiences a negative wealth shock, immediately decreasing consumption. See Monacelli and Perotti (2008) for a detailed discussion.

shocks. Intuitively, assets that co-vary positively with the government spending shock appreciate when the marginal wealth is low. Thus agents command a higher premium to compensate for risk.

The temporary increase in consumption disappears as habit persistence increases. However, the contemporaneous decrease in the stochastic discount factor is noncontingent on the temporary increase in consumption.[32] The temporary increase in consumption is a possible but not a necessary condition that generates the positive risk premium associated with government spending shocks.

2.6.8.2. *Return spread between the $GOVT$ sector and the $PRIV$ sector.* Figure 2.6 also shows that the return spread between the $GOVT$ sector and the $PRIV$ sector contemporaneously increases upon a positive government spending shock. This formalizes the use of the GMP return spread to approximate government spending shocks.

However, a positive TFP shock to the $GOVT$ sector also generates a positive return spread.[33] I use three approaches to show that the empirical counterpart of the return spread between the $GOVT$ sector and the $PRIV$ sector captures news shocks to government spending. Firstly, I compare the empirical response of consumption, tax rate and wages to the model solutions. I find that consumption, investment and wages increase for 20 quarters while the tax rate contemporaneously decreases following a positive shock to TFP in the $GOVT$ sector.[34] Thus, a positive shock to TFP generates the opposite dynamics to that of a positive shock to government spending. The empirical macroeconomic responses in Figure 2.2 are consistent with

[32] This case is not reported in paper.

[33] This is an unlikely scenario in reality. Defence contractors are unlikely to increase the production of military goods due to technology improvements.

[34] Results not reported in the paper and are available on request.

the simulated responses generated by shocks to government spending. Secondly, I examine whether a positive shock to the GMP returns correspond to a significant increase in the TFP in defence industries. I find no statistically significant difference in TFP in the defence industries following a shock to the GMP portfolio returns. Finally, I find that the response of macroeconomic variables in the VAR estimation is robust to the inclusion of TFP in the defence industries.

Overall, the model successfully generates the consumption dynamics observed in data. In addition, the model successfully formalizes the use of the GMP return spread as a plausible approximate of government spending shocks.

2.7. Conclusion

In this paper, I introduce a novel exogenous measure of news shocks to government spending to analyze the implications of fiscal spending shocks on asset prices. The proposed measure, the returns to the portfolio long firms that contribute most of their value to the government sector minus firms that contribute most of their final value to the private sector, the returns to the GMP portfolio, significantly forecasts future real per capita government spending. I provide evidence that a positive government spending shock contemporaneously increases consumption and non-residential investment but decreases consumption, non-residential investment and real wages in the long run as tax liabilities increase. The estimated output multiplier, the ratio of the change in output to the change in government spending, is 0.85 evaluated after two years.

Portfolio sorting and cross sectional asset pricing tests show that government spending shocks explain the cross section of asset returns. I show that assets with high exposure to government spending shocks earn higher expected returns, on average, compared to assets with low exposure to government spending shocks. The positive premium is robust to the use of different test portfolios and to the inclusion of different risk factors. The positive risk premium is consistent with government spending shocks causing contemporaneously low marginal utility states.

In addition, I show a positive association between firm level book-to-market ratio and the sensitivity to government spending shocks. I find that value firms have higher exposure to government spending shocks than growth firms. Investors are willing to hold growth firms, despite their lower average returns, since they have lower sensitivity to fiscal shocks.

I develop a two sector real business cycle model to explain the key empirical insights. I show that the inclusion of correlated news shocks to government consumption and government investment, and distortionary taxes generates a temporary low marginal wealth state following a government spending shock. Finally, the model formalizes the use of the GMP portfolio returns to approximate government spending shocks.

Table 2.1. GOVT Minus PRIV: Portfolio Composition

	PRIV			GOVT		
Characteristic	Median	10%	90%	Median	10%	90%
Book-to-market equity	0.739	0.197	2.217	0.645	0.231	1.505
Debt-to-assets	0.265	0.002	0.520	0.196	0.000	0.432
Cash flows-to-assets	0.080	-0.010	0.160	0.087	0.024	0.147
Gross profitability	0.335	0.097	0.792	0.286	0.127	0.466
Investment-to-assets	0.061	-0.112	0.241	0.072	-0.103	0.255

This table reports the portfolio composition of the GOVT firms, private sector firms that add most its final value to the government sector, and PRIV firms, private sector firms that add most its final value to private sector consumption. I report the market equity, book-to-market equity, debt to assets ratio (Compustat item dltt plus item dlc divided item at), the cash flows to assets ratio (Compustat item ib plus item dp divided by item at), the gross profitability (Compustat item revt minus item cogs divided by item at) and the investment to assets ratio (change in Compustat item at divided by lag item at). The sample includes data from 1965 to 2014.

Table 2.2. Portfolios Sorted on GMP beta

	L	2	3	4	5	6	7	8	9	H	H-L
a) Post-War Sample (1947/07 - 2016/12)											
Mean excess returns	0.351	0.485	0.525	0.646	0.676	0.772	0.791	0.830	0.843	0.913	0.562
(t-stat)	(1.61)	(2.96)	(3.59)	(4.16)	(4.28)	(4.44)	(4.33)	(4.16)	(3.76)	(3.44)	(2.89)
α_{CAPM}	-0.317	-0.065	0.017	0.116	0.137	0.183	0.179	0.165	0.109	0.095	0.412
(t-stat)	(-2.32)	(-0.87)	(0.29)	(2.07)	(2.35)	(2.86)	(2.32)	(1.98)	(1.08)	(0.65)	(1.96)
$\alpha_{3-Factor}$	-0.252	-0.051	0.014	0.097	0.108	0.189	0.105	0.109	0.045	0.018	0.270
(t-stat)	(-2.03)	(-0.72)	(0.25)	(1.67)	(1.87)	(3.07)	(1.41)	(1.37)	(0.48)	(0.17)	(1.70)
b) Post-Nasdaq Sample (1971/02 - 2016/12)											
Mean excess returns	0.263	0.419	0.412	0.567	0.691	0.734	0.780	0.798	0.827	0.948	0.685
(t-stat)	(0.89)	(2.10)	(2.27)	(3.05)	(3.55)	(3.34)	(3.42)	(3.36)	(3.17)	(2.95)	(2.76)
α_{CAPM}	-0.364	-0.080	-0.042	0.088	0.203	0.200	0.219	0.198	0.164	0.200	0.564
(t-stat)	(-2.03)	(-0.88)	(-0.62)	(1.31)	(3.08)	(2.58)	(2.36)	(1.85)	(1.36)	(1.12)	(2.16)
$\alpha_{3-Factor}$	-0.281	-0.051	-0.028	0.068	0.166	0.198	0.128	0.137	0.101	0.109	0.390
(t-stat)	(-1.72)	(-0.57)	(-0.44)	(0.97)	(2.52)	(2.66)	(1.49)	(1.34)	(0.87)	(0.82)	(1.96)
c) Characteristics (1947/07 - 2016/12)											
β^{GMP}	-0.644	-0.259	-0.127	-0.031	0.055	0.140	0.236	0.352	0.517	0.995	
β^{MKT}	1.376	1.119	1.030	1.003	1.008	1.040	1.062	1.097	1.162	1.252	
BE/ME	0.922	0.955	0.890	0.929	0.918	0.978	0.989	1.018	1.073	1.081	
Size	0.698	2.081	2.455	2.400	2.253	1.836	1.497	1.193	0.781	0.366	

The table reports summary statistics of value-weighted excess returns on 10 portfolios (deciles) of firms sorted on the exposure to the GMP returns (β^{GMP}). I also report the monthly excess returns over the CAPM (α_{CAPM}), and the excess returns over the Fama and French (1993) three-factor model ($\alpha_{3-Factor}$). The sample excludes firms that produce goods and services for the government sector. β^{GMP}, and β^{MKT} are calculated using a regression with the prior 60 months of data. In addition, I report the average book equity to market equity (BE/ME) ratio and market equity (Size). The t-statistics are reported in brackets using Newey and West (1987) standard errors, allowing for six lags. The sample includes yearly data from July 1947 to December 2016.

Table 2.3. Estimated Quarterly Risk Premia

Factor	(I)	(II)	(III)	(IV)	(V)	(VI)	(VII)	(VIII)
MKT	0.063	-0.086	-0.217	-0.265	-0.125	-0.173	-0.196	-0.291
	(0.24)	(-0.35)	(-0.94)	(-1.13)	(-0.56)	(-0.76)	(-0.75)	(-1.09)
GMP		0.799**		0.816**		0.755**		0.760**
		(2.39)		(2.74)		(2.61)		(2.55)
HML			0.323**	0.314**	0.333**	0.341**	0.342**	0.353**
			(2.53)	(2.49)	(2.67)	(2.74)	(2.41)	(2.52)
SMB			0.173	0.164	0.173	0.154	0.122	0.111
			(1.38)	(1.33)	(1.39)	(1.24)	(0.89)	(0.82)
UMD					-0.018	-0.067		
					(-0.08)	(-0.31)		
RMW							0.036	0.060
							(0.30)	(0.49)
CMA							0.241**	0.267**
							(2.55)	(2.78)
INT	0.748**	0.824**	0.867**	0.915**	0.783**	0.837**	0.829**	0.915**
	(4.51)	(5.30)	(5.92)	(6.19)	(5.71)	(5.95)	(5.17)	(5.67)
Adj R^2	0.23	0.31	0.44	0.48	0.47	0.50	0.51	0.53

This table reports the second-stage Fama and MacBeth (1973) cross sectional estimates using 75 test portfolios. The first-stage time series betas were computed using a 60 month rolling window. The test portfolios include 25 portfolios sorted on book-to-market and size, 25 portfolios sorted on GMP beta and size, and 25 portfolios sorted on MKT beta and size. The t-statistics are reported in brackets using Newey and West (1987) corrected standard errors. MKT is the excess return on the CRSP value-weighted portfolio and GMP is the returns on a portfolio long GOVT firms minus PRIV firms, which captures shocks to government spending. SMB, HML, RMW, CMA, and MOM are the size, value, profitability, investment, and momentum factors. The specification (III) is the Fama and French (1993) 3-factor model, specification (V) is the Carhart (1997) 4-factor model, and specification (VII) is the Fama and French (2015) 5-factor model. Adj $R^2$is the time series average of the adjusted $R^2$from the second-pass regressions. Specifications (I) - (VI) include monthly data from July 1947 to December 2016 and specifications (VII) - (VIII) include monthly data from July 1963 to December 2016. * Significant at the 10 percent level. ** Significant at the 5 percent level.

Table 2.4. Cross Sectional Tests - Robustness

	25 portfolios sorted on BE/ME and Size					
Factor	(I)	(II)	(III)	(IV)	(V)	(VI)
MKT	1.174		-0.733	2.421		-1.909
	(0.59)		(-0.41)	(1.58)		(-0.95)
TFP		1.176			3.056	
		(0.73)			(1.17)	
GMP	5.651***	5.356***	3.344**			
	(2.79)	(2.65)	(2.52)			
Defence				9.706**	9.063**	9.691**
				(2.13)	(2.21)	(2.28)
SMB			0.709			0.727*
			(1.17)			(1.82)
HML			1.352*			1.097**
			(1.95)			(2.52)
Intercept	1.624	2.141*	3.596**	0.714	2.156***	4.945**
	(0.80)	(1.90)	(2.08)	(0.44)	(2.62)	(2.30)
J-stat	11.794	11.914	3.749	8.226	7.839	5.070
p-value	(0.96)	(0.96)	(0.99)	(0.99)	(0.99)	(0.99)
MAPE	2.644	2.704	1.784	2.686	2.643	1.845

This table reports the first-stage GMM estimates using the identity weighting matrix. I report the mean absolute pricing errors (MAPE) and the J-test of overidentifying restrictions along with p-values in brackets. The t-statistics are reported in brackets using Newey and West (1987) standard errors, allowing for four lags. I use two proxies for productivity shocks: returns on the market portfolio (MKT) and the total factor productivity (TFP). I use two proxies for Government Spending Shocks: Returns to the GMP portfolio, the returns to the portfolio long GOVT firms minus PRIV firms, and Ramey (2011*a*) defense news measure, Defence. Specifications (I)-(III) include quarterly data from 1963 to 2014 and specifications (IV)-(VI) include quarterly data from 1939 to 2014 . * Significant at the 10 percent level. ** Significant at the 5 percent level. *** Significant at the 1 percent level.

Table 2.5. Parameters Used for Benchmark Caliration

Parameter	Symbol	Value
Preferences:		
Discount factor	β	0.99
Governs disutility of labor	ψ	0.0006
Governs intertemporal substitution	θ	2.4
Governs intertemporal substitution of the consumption-hours bundle	σ	1.1
Governs the wealth effect (GHH preferences, γ= 0, KPR preferences, γ= 1)	γ	0.8
Degree of internal habit formation	h	0.32
Adjustment costs:		
Investment adjustment cost parameter in sector 1	ϕ_1	1.3
Investment adjustment cost parameter in sector 2	ϕ_2	1.3
Capital depreciation rate	δ	2.5%
Production:		
Labor share in sector 1	α_1	0.64
Capital share in sector 2	α_k	0.36
Public capital share in sector 2	α_g	0.15
Persistence of TFP shock in each sector	ρ_A^i	0.9
Volatility of the TFP shock in each sector	$\sigma_{\epsilon^{A_i}}$	0.86%
Persistence of IST shock	ρ_Z	0.9
Volatility of the IST shock	σ_{ϵ^Z}	1.0%
Persistence of government investment shock	$\rho_1^{gi}, \rho_2^{gi}, \rho_3^{gi}$	1.4, -0.25, -0.2
Persistence of government consumption shock	$\rho_1^{gc}, \rho_2^{gc}, \rho_3^{gc}$	1.4, -0.25, -0.2
Correlation between ϵ^{gi} and ϵ^{gc}	$\rho_{gi,gc}$	0.5
Volatility of a shock to government investment	$\sigma_{\epsilon^{gi}}$	1.0%
Volatility of a shock to government consumption	$\sigma_{\epsilon^{gc}}$	1.5%

Table 2.6. Model versus Data: Macroeconomic Quantities

A. Data							
	Volatility			Correlation			
	1947-2015	1963-2015		$\dot{c}$	$\dot{i}$	$\dot{n}$	$\dot{y}$
$\dot{c}$	1.260	1.211	$\dot{c}$	1.000			
$\dot{i}$	4.652	4.688	$\dot{i}$	0.634	1.000		
$\dot{n}$	1.550	1.457	$\dot{n}$	0.638	0.856	1.000	
$\dot{y}$	1.628	1.481	$\dot{y}$.	0.772	0.773	0.864	1.000

B. Model						
	Volatility		Correlation			
			$\dot{c}$	$\dot{i}$	$\dot{n}$	$\dot{y}$
$\dot{c}$	1.800	$\dot{c}$	1.000			
$\dot{i}$	5.860	$\dot{i}$	0.433	1.000		
$\dot{n}$	0.560	$\dot{n}$	0.250	0.634	1.000	
$\dot{y}$	2.010	$\dot{y}$.	0.938	0.694	0.416	1.000

This table compares moments of the data to simulated moments from the model. The empirical moments are computed using quarterly data from the U.S. Bureau of Economic Analysis. I de-trend the data with the HP filter with a smoothing parameter of 1,600. The theoretical moments are estimated by simulating the model for 10,000 periods and dropping the first half of the observations to remove the dependence on initial values. I consider innovations in consumption $\dot{c}$, innovations in non-residential investment $\dot{i}$, innovations in labor supply $\dot{n}$ and innovations in output $\dot{y}$. Correlations are computed using quarterly data from 1947 to 2014 de-trended with the HP filter to capture the business cycle properties.

Table 2.7. Model versus Data: Asset Pricing Moments

Aggregate Moments		
	Data	Benchmark
Risk premium of the market portfolio	6.502	2.760
Volatility of the market portfolio	18.09	16.20
Sharpe ratio of the market portfolio	35.9	17.0
Average risk-free rate	2.900	4.120
Volatility of risk-free rate	3.00	4.96

The table compares key asset pricing moments of the data to simulated moments from the model. I estimate the responses by simulating 20,000 periods. I drop the first half of the observations to remove the dependence on initial values. All figures are in percentage terms. The equity return moments are computed from 1927 to 2014 sample. The moments of the risk-free rate are from the long sample of Campbell and Cochrane (1999).

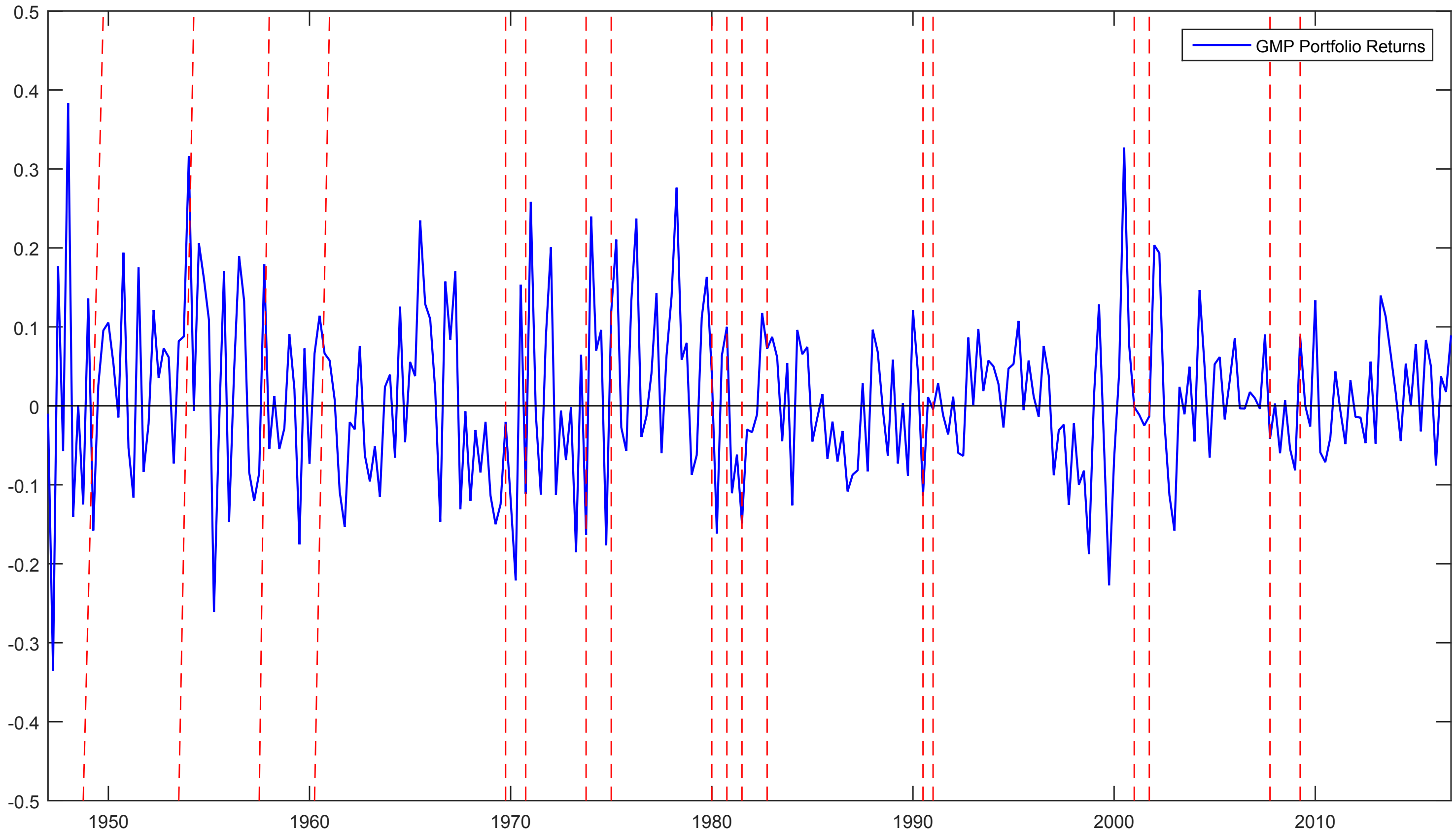
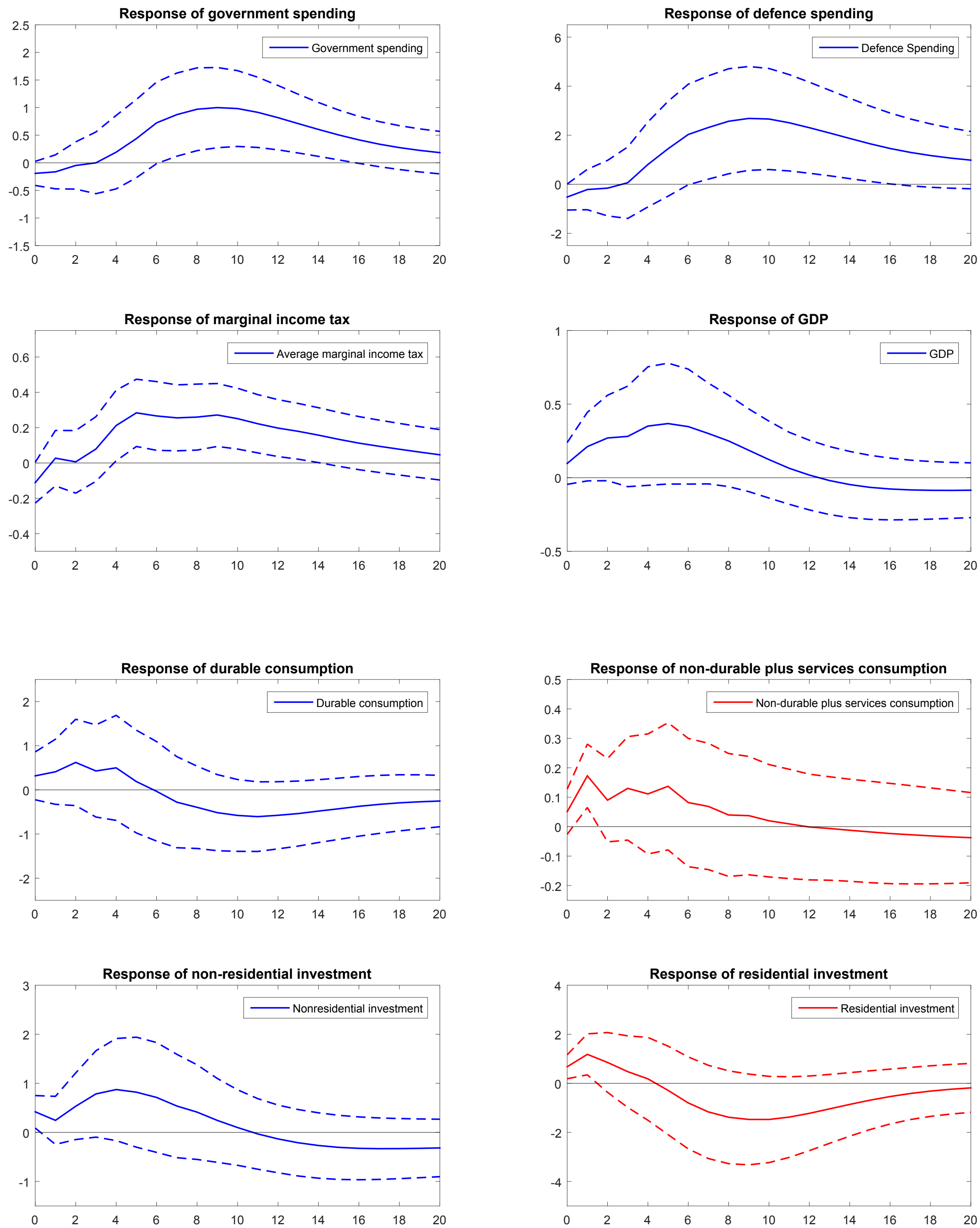


Figure 2.1. GMP Returns versus Real Government Spending
This figure presents the returns on the GMP portfolio, portfolio long firms which contribute most of their final value to the government sector ($GOVT$) minus firms that contribute most of their final value to the private sector ($PRIV$). The dashed lines show the NBER recessions. The sample includes data from July 1947 to December 2016.


Response of government spending
Government spending
Response of defence spending
Defence Spending
Response of marginal income tax
Average marginal income tax
Response of GDP
GDP
Response of durable consumption
Durable consumption
Response of non-durable plus services consumption
Non-durable plus services consumption
Response of non-residential investment
Nonresidential investment
Response of residential investment
Residential investment

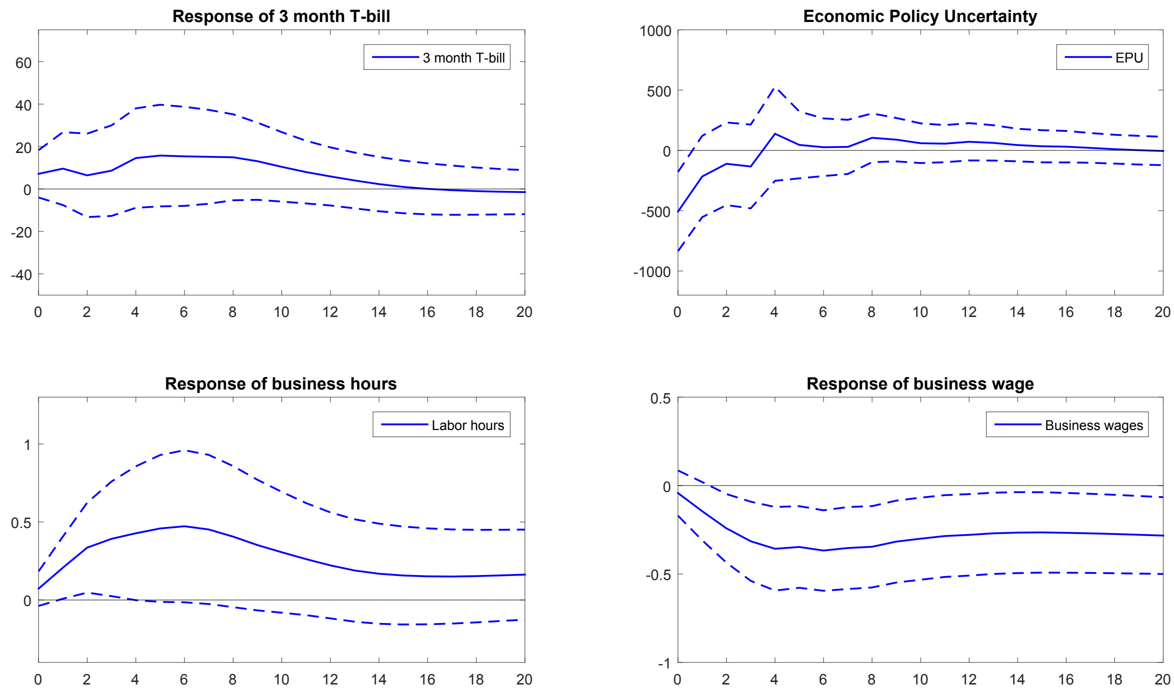


Figure 2.2. Responses to a positive Government Spending shock

This figure presents the response functions of macroeconomic variables to a positive government spending shock. The government spending shock is approximated using the GMP return spread, portfolio long firms which contribute most of their final value to the government sector (GOVT) minus firms that contribute most of their final value to the private sector (PRIV). The responses are normalized such that the maximum response of real government spending is equal to one. The vector autoregression (VAR) consists of a fixed set of variables (per capita defence spending, per capita government spending, Barro and Redlick (2011) average marginal income tax rate, per capita labor hours, excess returns on the market portfolio, and three-month Treasury bill rate) plus four lags of each variable. I rotate in other variables of interest one at a time. The dashed lines represent 95% bootstrapped standard error bands. The sample includes quarterly data from July 1947 to December 2008.

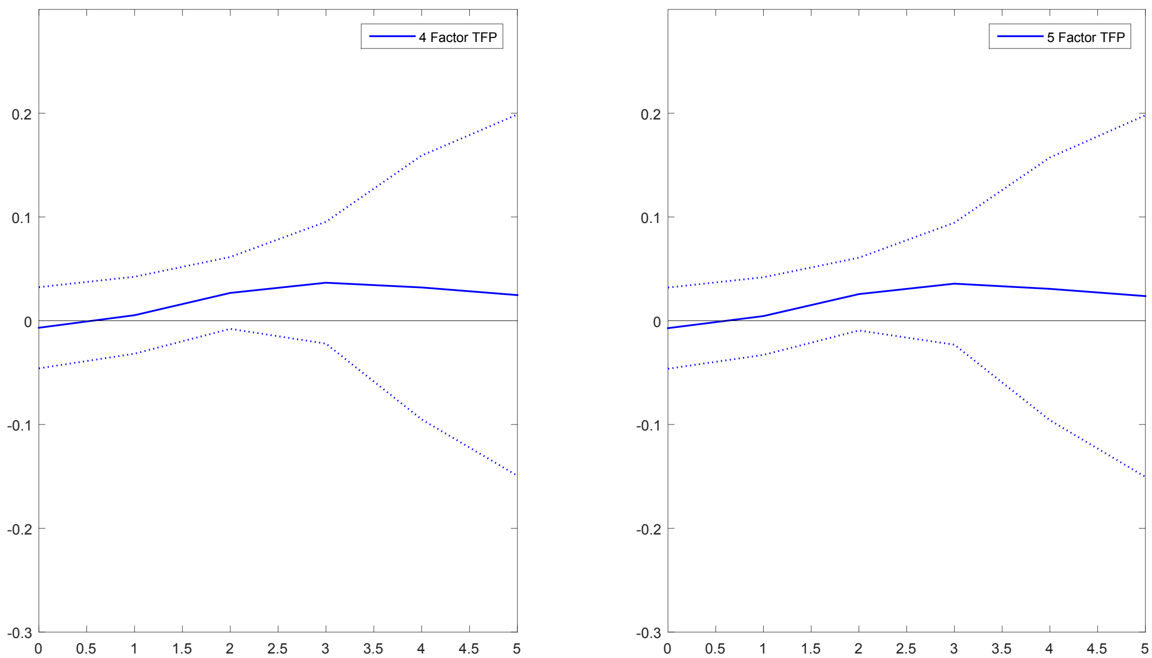


Figure 2.3. Response in Industry Level GOVT Sector TFP

I explore the response of industry level TFP in the $GOVT$ sector using local projections using the panel regression in 2.2 . The predicted variables are the 4-factor TFP, including capital (K), production worker hours (N), non-production worker hours (L), and materials (M), as well as the 5-factor TFP, which splits the materials variable into energy (E) and non-energy materials (M-E). The TFP data is from the NBER-CES Manufacturing Industry Database. The dotted lines represent 95% standard error bands corrected for Newey and West (1987) procedure. The sample includes quarterly data from 1958 to 2011.

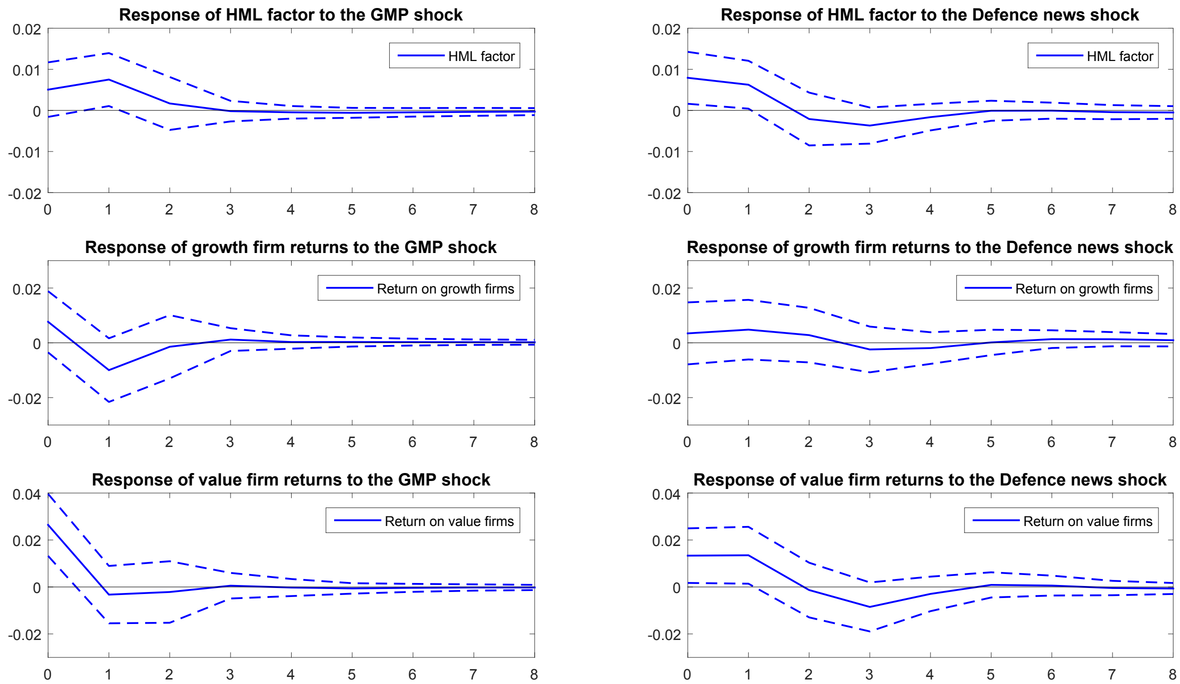


Figure 2.4. Responses to a positive Government Spending shock

The dotted lines represent 95% bootstrapped standard error bands. The figure presents the response of the HML factor to a positive shock to the GMP portfolio returns, using data from 1965 to 2008. HML factor, the spread in returns between high and low Book-to-Market firms, is from Kenneth French's Web site.

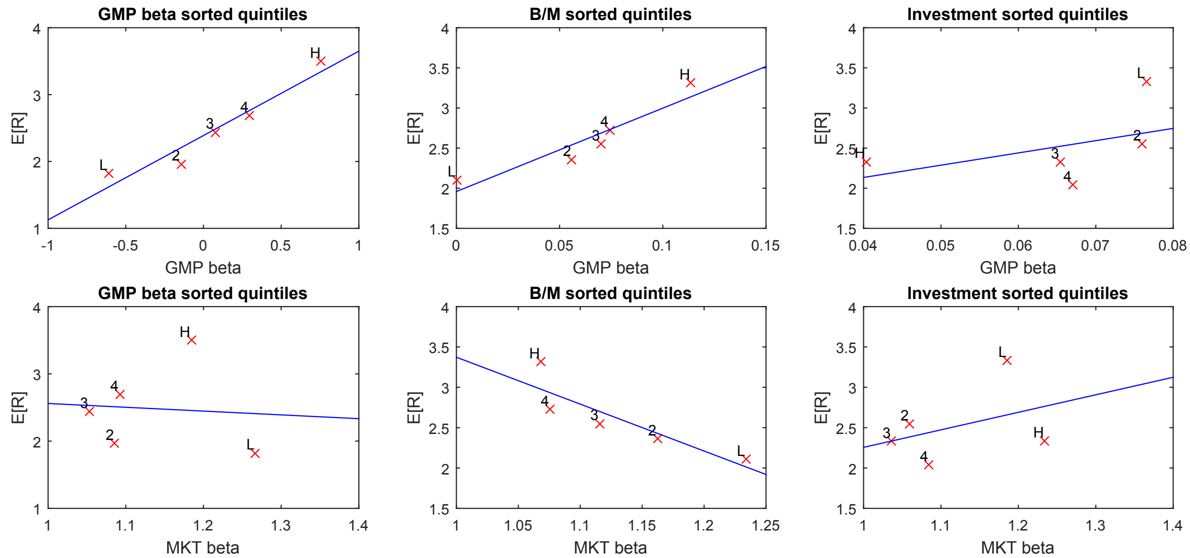


Figure 2.5. Portfolios sorted on GMP betas, Book-to-Market equity and Investment

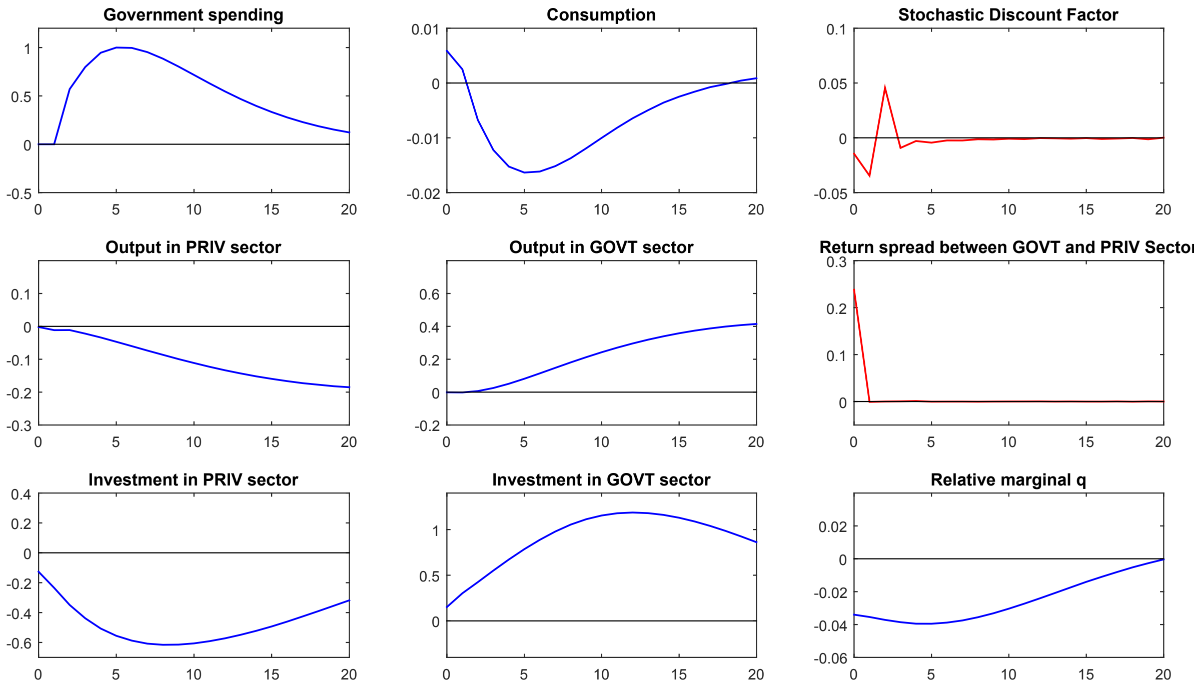


Figure 2.6. Simulated Responses to a Governmen Spending Shock

The figure plots the model response of macroeconomic variables to a positive government spending shock. Specifically, the figure shows quarterly log-deviations from the steady-state. All the parameters are calibrated to the values reported in Table 2.5 . The responses are normalized such that the maximum response of government spending is equal to one.

CHAPTER 3

Trade Induced Productivity Change and Asset Prices

3.1. Introduction

The presidential election in the U.S. and the British withdrawal from the European Union have brought international trade theory to the forefront of policy debates. Literature suggests that as trade policy barriers fall, firms active in industries more predisposed to exporting such as manufacturing and mining experience gains through economies of scale and via expansion of product varieties available to consumers.[1] Trade liberalization also allows local firms to access cheaper intermediate goods.[2] In addition, trade liberalization raises the average industry productivity through reallocation of resources from low to high productive firms. Despite strong micro evidence for the trade liberalization and productivity nexus within certain industries, literature remains divided on the aggregate implications of trade liberalization. The difficulty in identifying a valid instrument for exporting has limited researchers the capability to quantify the implications relating firm access to foreign markets. The endogeneity and predictability eliminate the application of innovations in real exports as an approximation of trade induced productivity change. In this paper, I explore the implications of trade induced productivity change on macroeconomic dynamics and equity prices by introducing a novel exogenous measure of trade induced productivity change.

[1]Notable literature includes, but not limited to, Pavcnik (2002), Trefler (2004), Bernard, Jensen, and Schott (2006a), Broda and Weinstein (2006), and Lileeva and Trefler (2010).
[2]The recent literature which links trade with cheaper intermediate goods includes Goldberg, Khandelwal, Pavcnik, and Topalova (2010), and De Loecker, Goldberg, Khandelwal, and Pavcnik (2016).

I show that financial data can be used to measure trade induced productivity change. The novel measure is the returns to the portfolio long firms producing tradable goods minus firms producing non-tradable goods, the returns to the TMN portfolio. The TMN return spread captures trade induced productivity since reductions in trade barriers and costs benefit industries that produce tradable goods more relative to industries that produce non-tradable goods. The measure is available at a higher frequency, and thus suitable for asset pricing. I find that some of the larger shocks to the TMN portfolio returns correspond to trade negotiations such as the discussions that lead to the *North American Free Trade Agreement* (NAFTA), which reduced trade barriers and costs for many firms in the tradable goods sector. I show that a positive shock to trade induced productivity significantly increases real exports while decreasing the *terms of trade*, the relative price of exports in terms of the price of imports.[3] Greater trade integration increases investment opportunities, thus in the short-run, resources are reallocated from household consumption to investment, which further raises the aggregate productivity. The increase in investment following trade integration is consistent with recent micro level findings in literature (Constantini and Melitz (2008), Lileeva and Trefler (2010), Bustos (2011)). In the long-run, both durable and non-durable consumption increase above the steady-state levels.

The sign of the risk premium reveals whether trade induced productivity shocks cause positive or negative marginal utility of wealth states. Asset pricing tests show that trade induced productivity shocks carry a robust negative risk premium. Assets with high sensitivity to the trade induced productivity shock have lower returns, on average, compared to assets with low sensitivity to the trade induced productivity

[3]The decrease in terms of trade imply that positive shocks to the TMN portfolio returns capture supply side productivity shocks rather than demand shocks.

shock. The annualized return for the long-short portfolio sorted on the exposure to the trade induced productivity shock is approximately -6.7 percent.[4] In addition, I find that the risk premium associated with trade induced productivity is stronger among larger firms and high investment firms. Intuitively, reductions in trade barriers and costs have a greater impact on larger firms with more aggressive investment strategies since such firms have the ability to compete in international competitive markets.

A two-sector real business cycle model formalizes the intuition and details the mechanism through which trade induced productivity shocks impact asset returns. The model presents three testable implications: (1) the long-short portfolio of firms in the tradable goods sector minus non-tradable goods sector approximates trade induced productivity change, (2) trade induced productivity decreases consumption and *terms of trade* while increasing investment and exports in the short term, and (3) trade induced productivity causes high marginal wealth states for households with *late resolution of uncertainty.* Households with *late resolution of uncertainty* prefer smoothing consumption stream over time rather than across states. Such households prefer assets with high exposure to the trade induced productivity shock as they deliver high returns during times of high marginal utility of wealth states.

I examine whether trade induced productivity shocks are systematic through standard asset-pricing tests, and therefore whether such shocks are priced in the cross section of equity returns. Employing plausible empirical asset-pricing specifications in which the TMN return spread is used as a factor, I find that trade induced productivity change explicate the cross section of equity returns. The different specifications consists of empirical asset-pricing models which include as factors the excess returns

[4]Both equal-weighted and value-weighted long-short portfolio returns are statistically significant at the conventional levels.

on the market portfolio, size, book-to-market, investment, profitability, and momentum. I show that the trade induced productivity change is negatively priced in all of specifications.

This paper contributes to the growing literature that explores the effects of globalization on asset returns. Tian (2017) finds that firms with high tradability have more cyclical asset returns, and more cyclical earnings growth compared to firms with low tradability. In contrast to Tian's study, I use a different classification procedure to sort industries in to tradable and non-tradable sectors. Moreover, I examine the implications of trade induced productivity change on the cross section of asset returns, whereas Tian studies the implications of tradability on cyclical properties of asset returns. This paper is closely related to Barrot, Loualiche, and Sauvagnat (2016) which investigates domestic consequences of foreign productivity shocks. Using industry level shipping costs as an inverse measure of exposure to globalization, they find that firms more exposed to globalization command a positive risk premium.[5] Complementary to Barrot, Loualiche and Sauvagnat, I explore the consequences of domestic productivity change resulting from reductions in trade barriers and costs on asset returns.

This study also contributes to the literature that explores the export led growth hypothesis. International trade literature has long been debating whether trade causes economic growth. Early studies document a positive association between trade and long-term growth and have attributed the growth to gains through economies of scale, better capacity utilization, and better technological improvements (Balassa (1978); Feder (1983); Kormendi and Meguire (1985)). In contrast, Levine and Renelt (1992)

[5]Barrot, Loualiche and Sauvagnat find that firms more exposed to globalization co-vary positively with investor's consumption in the U.S.

find insufficient evidence for the trade and long-term growth nexus. I find that, trade liberalization weakly contributes to long-term growth in the U.S. However, I find stronger evidence for trade led growth in the special case of limited foreign import competition.[6] Specifically, output significantly increases following a positive shock to trade induced productivity controlling for import competition from China, using the measure in Autor, Dorn, and Hanson (2013*a*).[7]

The paper is organized as follows. Section 3.2 presents a theoretical model that motivates the empirical work. Section 3.3 introduces the novel measure of trade induced productivity change. Section 3.4 explores the macroeconomic dynamics. Section 3.5 shows the asset pricing results and section 3.6 concludes.

3.2. Real Business Cycle Model

This section presents a simple two-sector real business cycle (RBC) model that motivates the empirical analysis.[8] Specifically, I link trade induced productivity change with asset returns and the *terms of trade*. The model presents three testable implications: (1) the long-short portfolio of firms in the tradable goods sector (T) minus non-tradable goods sector (N) approximates trade induced productivity change, (2) trade induced productivity decreases consumption and *terms of trade* while increasing investment and exports in the short term, and (3) trade induced productivity

[6]I study macroeconomic dynamics for the time period from 1965 to 2015. However, for the special case in which I control for Chinese import competition, I examine macroeconomic dynamics for the time period from 1987 to 2007. The shorter time period results from limited data availability of Chinese import competition measure.

[7]Some of the recent literature employs the rise in imports from China to the U.S. as a trade shock (see, for e.g., Autor, Dorn, and Hanson (2013*a*); Autor, Dorn, Hanson, and Song (2014); Bloom, Draca, and Van Reenen (2016)). Chinese import competition is usually considered an exogenous measure since it is not driven by a decline in local productivity or changes in local demand in the US.

[8]For simplicity, I eschew incorperating long run risks (see, Bansal and Yaron (2004)), a sector producing investment goods (see, for e.g., Papanikolaou (2011); Garlappi and Song (2016*a*)), and utility maximizing households in foreign countries (e.g., Grüning (2017)).

causes high marginal wealth states for households with late resolution of uncertainty. In addition, I show that correlated shocks between factor productivity in the T-sector and marginal efficiency of investment (MEI), the rate of transformation between investment goods and installed capital, generates the consumption dynamics observed in data. In the empirical analysis, I confirm that a positive shock to trade induced productivity significantly increases MEI.

3.2.1. Households

The model economy is populated by identical households that derive their lifetime utility from consumption, C_t, and labor supply, L_t, according to the following recursive structure (Epstein and Zin (1989); Weil (1989)) given by

$$U_t = \left\{ (1-\beta)\left[C_t\left(1-\psi L_t^{\theta}\right)\right]^{1-\frac{1}{\Psi}} + \beta \mathbb{E}_t\left[U_{t+1}^{1-\gamma}\right]^{\frac{1-1/\Psi}{1-\gamma}} \right\}^{\frac{1}{1-1/\Psi}}, \tag{3.1}$$

where β is the time discount rate, Ψ is the elasticity of intertemporal substitution (EIS), γ is the coefficient of relative risk aversion (RRA). The parameter ψ measures the degree of disutility to labor, and θ measures the sensitivity of disutility to labor. The recursive preferences reduces to King, Plosser, and Rebelo (1988) time separable constant relative risk aversion (CRRA) utility when $\frac{1}{\Psi} = \gamma$.[9]

Households supply labor $L_{N,t}$ and $L_{T,t}$ to the non-tradable goods and tradable goods sectors, respectively. Households maximize their utility according to

$$V_t = \max_{\{C_S, L_S\}_{S=t}^{\infty}} U_t, \;\; \text{s.t. } C_S = w_S(L_{N,S} + L_{T,S}) + D_{N,S} + D_{T,S}, \;\; s \geqslant t, \tag{3.2}$$

[9]In the special case of $1/\Psi = \gamma$, the recursive preferences reduces to time seperable CRRA preferences in the form of $U_t = \sum_{j=0}^{\infty} \frac{\beta^j \left[C_{t+j}\left(1-\psi L_{t+j}^{\theta}\right)\right]^{1-\gamma}}{1-\gamma}$.

where w_S is the market wage, and $D_{N,S}$ and $D_{T,S}$ are the dividend streams of N-sector and T-sector firms. The one-period ahead *stochastic discount factor* (SDF) at time t is,

$$\mathbb{M}_{t,t+1} = \beta \left(\frac{C_{t+1}}{C_t}\right)^{-\frac{1}{\Psi}} \left(\frac{1-\psi L_{t+1}^{\theta}}{1-\psi L_t^{\theta}}\right)^{1-\frac{1}{\Psi}} \left(\frac{U_{t+1}}{\left[\mathbb{E}_t U_{t+1}^{1-\gamma}\right]^{\frac{1}{1-\gamma}}}\right)^{\frac{1}{\Psi}-\gamma}. \tag{3.3}$$

The risk free rate is $\mathbb{E}_t\left[\mathbb{M}_{t,t+1}\right] = \frac{1}{R_t^f}$.

3.2.2. Firms and Technology

The production of goods and services takes place in two sectors: the non-tradable goods sector and the tradable goods sector. In both sectors, labor and capital are used as inputs for production.

3.2.2.1. Non-tradable Goods Sector (N-sector). The N-sector produces output Y_N according to the following Cobb-Douglas production function

$$Y_{N,t} = A_t K_{N,t}^{\beta_N} L_{N,t}^{1-\beta_N}, \tag{3.4}$$

where A is the neutral total factor productivity (TFP), K_N is the capital in non-tradable goods sector, and L_N is the labor supply in the N-sector. The output in the N-sector is used in household consumption. Without loss of generality, the price of N-sector good is set to be the numeraire with a price of one. The TFP shock is mean-reverting and evolves according to the specification

$$\log(A)_{t+1} = \rho^A \log(A)_t + \epsilon_{t+1}^A, \tag{3.5}$$

where $|\rho^A| < 1$, and $\epsilon_t \sim N\left(0, \sigma^2_{\epsilon^A}\right)$. The dividend stream for N-sector is

$$D_{N,t} = Y_{N,t} - w_t L_{N,t} - I_{N,t}, \tag{3.6}$$

where I_N is the investment in the N-sector.

3.2.2.2. Tradable Goods Sector (T-sector). The tradable goods sector produces $Y_{T,t}$ at the relative price $p_{T,t}$, in terms of the N-good price. The T-sector goods are sold in the international markets. I assume that the reductions in trade barriers and costs only benefit the productivity in the T-sector. The production follows the Cobb-Douglas form

$$Y_{T,t} = A_t Z_t^T K_{T,t}^{\beta_T} L_{T,t}^{1-\beta_T}, \tag{3.7}$$

where Z^T is the trade induced productivity, K_T is the capital in the tradable sector and L_T is the labor supply in the T-sector. The trade induced productivity shock is mean-reverting and evolves according to the specification

$$\log\left(z_{t+1}\right)_{t+1} = \rho^z \log\left(z_{t+1}\right)_t + \epsilon^z_{t+1}, \tag{3.8}$$

where $|\rho^z| < 1$, and $\epsilon_t \sim N\left(0, \sigma^2_{\epsilon^Z}\right)$. The dividend stream for T-sector is

$$D_{T,t} = p_{T,t}\, Y_{T,t} - w_t L_{T,t} - I_{T,t}, \tag{3.9}$$

where I_T is the investment in the T-sector.

3.2.2.3. Consumption Bundle. The final consumption bundle takes a constant elasticity of substitution (CES) form

$$C(C_{N,t}, C_{M,t}) = \left[\chi \left(C_{N,t}\right)^{1-\frac{1}{\mu}} + (1-\chi)\left(C_{M,t}\right)^{1-\frac{1}{\mu}}\right]^{\frac{1}{1-\frac{1}{\mu}}}, \tag{3.10}$$

where $\mu > 0$ and $\chi \in (0,1)$. The parameter χ is the weight of N-goods in the final consumption bundle. The parameter μ represents the intratemporal elasticity of substitution between N-goods and imports. As the elasticity converges to unity, the aggregator converges to a Cobb-Douglas form with share parameter χ.[10] The price of imports in terms of the N-good is

$$p_{m,t} = \frac{1-\chi}{\chi}\left(\frac{C_{N,t}}{C_{M,t}}\right)^{\frac{1}{\mu}}. \tag{3.11}$$

3.2.2.4. Stock of Capital. I include Christiano, Eichenbaum, and Evans (2005) capital adjustment costs for both sectors of the economy. The capital accumulates according to

$$K_{x,t+1} = (1-\delta) K_{x,t} + \mu_t \left[1 - \frac{\phi_i}{2}\left(\frac{I_{x,t}}{I_{x,t-1}} - 1\right)^2\right] I_{x,t}, \tag{3.12}$$

where $\phi_x > 0$ for $x = N, T$. Following Justiniano, Primiceri, and Tambalotti (2010) and Justiniano, Primiceri, and Tambalotti (2011), I include the shock μ_t to the marginal efficiency of investment, which represents an exogenous disturbance to the process by which investment goods are transformed into installed capital. The shock to MEI evolves according to the following specification,

$$\log\left(\mu^{MEI}\right)_{t+1} = \rho^{\mu^{MEI}} \log\left(\mu^{MEI}\right)_t + \epsilon_{t+1}^{\mu^{MEI}}, \tag{3.13}$$

where $|\rho^{\mu^{MEI}}| < 1$, and $\epsilon_t^{\mu^{MEI}} \sim N(0, \sigma_{\epsilon^{\mu}}^2)$.

3.2.2.5. Correlated Shocks. Recent literature links reductions in trade barriers with cheaper intermediate goods (Goldberg, Khandelwal, Pavcnik, and Topalova

[10]Specifically, as $\lim_{\mu\to 1}\left[\chi (C_{N,t})^{1-\frac{1}{\mu}} + (1-\chi)(C_{M,t})^{1-\frac{1}{\mu}}\right]^{\frac{1}{1-\frac{1}{\mu}}} = (C_{N,t})^{\chi}(C_{M,t})^{1-\chi}$. See Uribe and Schmitt-Grohe (2015) for a indepth discussion of the aggregator functions used in international trade literature.

(2010); De Loecker, Goldberg, Khandelwal, and Pavcnik (2016)). To be consistent, I assume that reductions to barriers and costs increase T-sector productivity and the marginal efficiency of investment.[11] I find that the combination of correlated shocks to trade induced productivity and MEI generates the desired macro dynamic responses.[12] The variance-covariance matrix of the innovations ϵ^{z}_{t+1} and $\epsilon^{\mu^{MEI}}_{t}$ is

$$\begin{pmatrix} \sigma^2_{\epsilon^Z} & \rho_{Z,\mu}\sigma_{\epsilon^Z}\sigma_{\epsilon^\mu} \\ \rho_{Z,\mu}\sigma_{\epsilon^Z}\sigma_{\epsilon^\mu} & \sigma^2_{\epsilon^\mu} \end{pmatrix}, \tag{3.14}$$

where $corr\left(\epsilon^Z_t, \epsilon^\mu_s\right) = 0$, $corr\left(\epsilon^Z_t, \epsilon^Z_s\right) = 0$, and $corr\left(\epsilon^\mu_t, \epsilon^\mu_s\right) = 0$ for all $t \neq s$. The term $\rho_{Z,\mu}$ captures the correlation between the trade induced productivity shock and the shock to MEI.

To evaluate the asset pricing implications and macroeconomic dynamics, all shocks should be orthogonal to each other. To do so, I transform ϵ^{z}_{t+1}, using a Cholesky decomposition, such that the trade induced productivity shock is orthogonal to all other exogenous variation. The transformed orthogonalized trade induced productivity shock is $\upsilon^{z}_{t+1} = Q\epsilon^{z}_{t+1}$,
where $Q = \frac{1}{\left(1-\rho^2_{Z,\mu}\right)^{1/2}\sigma_{\epsilon^Z}\sigma_{\epsilon^\mu}} \begin{bmatrix} \left(1-\rho_{Z,\mu}\rho'_{Z,\mu}\right)^{1/2}\sigma_{\epsilon^\mu} & 0 \\ -\rho_{Z,\mu}\sigma_{\epsilon^\mu} & \sigma_{\epsilon^Z} \end{bmatrix}$. Similarly, the transformed orthogonalized MEI shock is υ^{μ}_{t+1}.

[11] I find that a stand alone shock to ϵ^{z}_{t+1} fails to generate the macroeconomic dynamics observed in data. Because of the perfectly competitive nature, a productivity increase through trade will increase the output T-goods but will decrease the price of T-goods such that there is no effect on $p_{T,t}\ Y_{T,t}$. Modelling correlated shocks are motivated by the use of composite shock to investment specific technological (IST) shocks and MEI in Papanikolaou (2011). While IST shocks and trade induced productivity change have a natural correlation, I find in that IST is not the driving factor behind the tradability results.

[12] Using VARs, I provide evidence that a shock to trade induced productivity increases the MEI.

3.2.2.6. Market Clearing. In equilibrium, all markets clear. Labor market, investment and output clearing dictates,

$$L_{T,t} + L_{N,t} = L_t,$$

$$I_{T,t} + I_{N,t} = I_t,$$

$$p_{T,t}\ Y_{T,t} + Y_{N,t} = Y_t. \tag{3.15}$$

Both sectors hire labor at the competitive wage rate w_t. The *terms of trade* at time t is

$$tot_t = \frac{p_{T,t}}{p_{m,t}}. \tag{3.16}$$

3.2.2.7. Asset Prices. Firms in each sector maximizes their value, that is the present value of the discounted cash flows,

$$V_{x,t} = \max_{\{I_N, L_N\}} \mathbb{E}_t \left[\sum_{s=1}^{\infty} \prod_{r=1}^{s} \mathbb{M}_{t+r} D_{x,t+s} \right], \tag{3.17}$$

where $D_{x,t+s}$ is the dividend stream in sector $x = T, N$, subject to the capital constraint in 3.12 . The gross return on a claim to the cash flows is

$$R_{x,t+1} = \frac{V_{x,t+1} + D_{x,t+1}}{V_{x,t}}, \quad x = T, N. \tag{3.18}$$

The model features three sources of uncertainty: the neutral TFP shock, trade induced productivity shock, and shock to MEI. Following Garlappi and Song (2016*a*), I define the projection of log *stochastic discount factor* in (3) spanned by the orthogonal shocks as

$$m_{t,t+1} = \ln(\mathbb{M}_{t,t+1}) = \mathbb{E}_t\left[m_{t,t+1}\right] \; - \frac{\lambda_t^a}{\sigma_a^2}\epsilon_{t+1}^a - \frac{\lambda_t^\mu}{\sigma_\mu^2}\upsilon_{t+1}^\mu - \; \frac{\lambda_t^z}{\sigma_z^2}\upsilon_{t+1}^z \;, \tag{3.19}$$

where ϵ_{t+1}^a, υ_{t+1}^μ, and υ_{t+1}^z are the three shocks and $\lambda_t^a, \lambda_t^\mu$ and λ_t^z are their market price of risk (i.e. the Sharpe ratio). The market price of risk for each shock is

$$\lambda_t^x = -\sigma_x^2 \frac{\partial m_{t,t+1}}{\partial \epsilon_{t+1}^x} \;\;, \;\; x = a, \; z, \; \mu. \tag{3.20}$$

The price of risk for the trade induced productivity change depends on the change in the SDF. The price of risk is positive (negative), if the trade induced productivity shock causes a decrease (increase) in the SDF.

3.2.3. Calibration

I calibrate the model to examine the implications of trade induced productivity change on asset returns and macro dynamics. I solve the model using second order approximations around the steady state.

3.2.3.1. Parameters. The parameters of the model are reported in Table 3.1 . The parameter values are taken from previous literature where possible.

Preferences. For the benchmark model, I set RRA to $\gamma = 1.1$, consistent with the real business cycle literature (e.g., King and Rebelo (1999), Papanikolaou (2011), Dissanayake (2017*a*)). I choose Ψ such that $EIS = 1.5$. The RRA and EIS values correspond to households with late resolution of uncertainty ($\gamma < 1/\Psi$). For the alternate simulation, I choose RRA to $\gamma = 1.1$ and $EIS = 0.33$. The low EIS in the alternate model ensures that households prefer early resolution of uncertainty ($\gamma > 1/\Psi$).

Following Jaimovich and Rebelo (2009), the sensitivity of labor disutility is set to $\theta = 1.4$.[13] I choose the parameter ψ such that the steady state the value L_t of labor hours is equal to 25% of the time in a year.

Production. I choose the shares of capital equal to $\beta_N = \beta_T = 0.36$, which is standard in literature the real business cycle literature. Following Papanikolaou, I set the capital depreciation rate equal to $\delta = 8.5\%$.

I set the share parameter $\chi = 0.65$. The recent *DSGE* models estimated using aggregate data find that the intratemporal elasticity of substitution μ is less than one (see, for e.g., Corsetti, Dedola, and Leduc (2008), and Justiniano and Preston (2010)). I set the intratemporal elasticity of substitution between non-tradable goods and imports $\mu = 0.82$ such that it is consistent with the *DSGE* model estimates. In steady state, the N-sector sector produces approximately 70 percent of the output, the T-sector producers 30 percent of the output, and imports account for 20 percent of the total output.

Productivity Shocks. Following Garlappi and Song, I set the volatility and persistence of A to 1% and 0.67, respectively. I set the correlation between Z and μ^{MEI} to $\rho_{Z,\mu} = 0.3$, such that the model generates the desired consumption dynamics to the trade induced productivity shock. I choose MEI volatility $\sigma^{MEI} = 2\%$, which is lower than the volatility estimate in Justiniano, Primiceri, and Tambalotti (2011).[14] For simplicity, I set the persistence of trade induced productivity shock and the shock to MEI to equal $\rho_z = \rho_\mu = 0.67$.

[13] This is slightly higher than the parameter chosen in the two-sector model in Garlappi and Song.

[14] Justiniano, Primiceri, and Tambalotti find a median MEI volatility of 5.8 and confidence interval of $(5.3, 6.2)$. Papanikolaou calibrate the model using a much higher MEI volatility of 13 percent.

Firms are financed approximately 40 percent by debt and 60 percent by equity in the U.S., whereas in the model, all firms are equity financed. Following Boldrin, Christiano, and Fisher (2001), I multiply the risk premium and volatility of returns by a factor 5/3 to better match the firms in data.

3.2.4. Model Predictions

Figure 3.1 presents the response of the key macroeconomic variables and the response of the *stochastic discount factor* in response to the trade induced productivity change.[15] A positive shock to trade induced productivity reduces consumption and increases investment in the short-run as a consequence of the positive correlation between trade and MEI. The *terms of trade* worsens as the price of the tradable good decreases. The output increases with the higher productivity in the T-goods sector.

The return spread between the T-goods sector minus the N-goods sector increases upon a positive trade induced productivity shock. This motivates the use of the TMN returns as an approximate of trade induced productivity change. The next section focuses on constructing this measure using financial data and validating the measure using real macroeconomic data.

As shown in (24), the price of risk for the trade induced productivity shock depends on the change in the *stochastic discount factor.* The model simulated responses show that the *stochastic discount factor* increases if the households have *late resolution of uncertainty.* Then, a positive shock to trade induced productivity causes high marginal utility of wealth states.[16] Intuitively, households with *late resolution of*

[15]The volatilities from the model calibrations are reported in Appendix 2 . The model generates realistic macroeconomic volatilities. However, the model generates low volatility for the risk premium.
[16]This is analogous to the case in which investment specific technological shocks cause high marginal utility states in Papanikolaou (2011).

uncertainty are more interested in smoothing consumption stream over time rather than across states. However, if the households have *early resolution of uncertainty*, a positive shock to trade induced productivity causes low marginal utility of wealth states. Intuitively, households with *early resolution of uncertainty* are more interested in smoothing consumption across states than over time. In section 3.5 , I examine the sign of the price of risk associated with the trade induced productivity change to distinguish between the two cases.

3.3. Measuring Trade Induced Productivity Change

This section introduces the exogenous measure of trade induced productivity change. Literature documents that differences between tradable and non-tradable firms exist even before the actual exporting activity begins. Some firms in the tradable goods sector wait to enter or abstain from entering the export market given the high sunk costs associated with exporting. Trade induced productivity allows firms to enter and compete in international competitive markets (see, for e.g., Roberts and Tybout (1997), Clerides, Lach, and Tybout (1998), Bernard and Jensen (1999)). In addition, the tradable goods sector in the U.S. has evolved over time; industries such as information technology maintenance and support have transformed from non-tradable to tradable sector over the last few years (see Hlatshwayo and Spence (2012) for a detailed analysis).[17]

The proposed measure needs to capture potentially tradable industries which are more predisposed to exporting but have yet to enter the global market, in addition to the industries that are already exporting. To do so, I use the Jensen and Kletzer

[17]Spence and Hlatshwayo employ this measure to explore the evolving characteristics and trends across industries in the tradable and nontradable sectors of the economy.

(2005) measure of geographical concentration of industries. This measure uses locational Gini coefficients to identify the tradability of an industry. Intuitively, industries that are more likely to produce tradable goods have higher geographic concentrations. Examples include the high-tech industries in Silicon Valley and the auto industry in Detroit.

3.3.1. Gini Measure

The Gini coefficient measures the statistical dispersion among values of a frequency distribution. A Gini coefficient of one implies full concentration whereas zero implies the opposite. Gini coefficients are calculated using a two-step process. The first step is to calculate the industry demand share which measures the concentration of demand for industry i in region p, which is denoted as

$$\text{(3.21)} \qquad \textit{Industry Demand Share } (IDS)_{i,p} = \sum_j \left(\frac{Y_{i,j}}{Y_i} \frac{\ln EMP_{j,p}}{\ln EMP_j} \right),$$

where $Y_{i,j}$ is the output of industry i used by industry j. The second step is to calculate the locational Gini coefficients by industry,

$$\text{(3.22)} \qquad Gini_i = \mid 1 - \sum_p \left(\sigma Y_{i,p-1} + \sigma Y_{i,p} \right) \left(\sigma IDS_{i,p-1} - \sigma IDS_{i,p} \right) \mid,$$

where p is the index regions sorted by industry share of industry employment. The notation $\sigma Y_{i,p}$ represents the cumulative share of industry i's employment in region p and $\sigma Y_{i,p-1}$ is the cumulative share of industry i's employment in the region with the next lowest share of industry employment. Lower values of $Gini_i$ suggests a low geographic concentration of industry i, which are then characterized as non-tradable.

Higher Gini coefficient indicates that the production of goods and services takes place in a location different from where it is consumed.

The seasonally-adjusted employment data by industry is from the Bureau of Labor Statistics' Current Employment Statistics and the value added data by industry is from the Bureau of Economic Analysis (BEA). The industry splits are constructed at the two-digit NAICS level. Controlling for industry demand share does not completely eliminate the possibility of picking up domestic tradability rather than international tradability. In order to eliminate such possibilities, I employ the Jensen and Kletzer (2005) and Hlatshwayo and Spence (2014) industry splits which adjusts for domestic tradability by using certain value judgments about the classifications of specific industries. The non-tradable industries include, but not limited to, administrative and waste services, accommodation and food services, arts, entertainment, recreation, construction industries, educational services, health care related industries, retail trade, and wholesale trade industries. The tradable industries include, but not limited to, agriculture, forestry, fishing, hunting, manufacturing, transportation and warehousing.

3.3.2. Financial Data

In the next step of the analysis, I link the tradable and non-tradable industries, identified by the two-digit SIC code, to the universe of stocks. I merge tradability classification with the ordinary common equity traded in New York Stock Exchange (NYSE), American Stock Exchange (AMEX) and NASDAQ obtained from the Center for Research in Security Prices (CRSP) of the University of Chicago. I exclude financial firms (SIC $6000 - 6799$) and utilities (SIC $4900 - 4949$) from the sample.

Accounting data is from the Compustat database. A firm must have a December fiscal-year end and at least three years of data to be included in the sample. The market value of equity (ME), the stock price times the number of shares outstanding, is computed end of June each year using CRSP data. Following Fama and French (1993), the book value of equity (BE) is the COMPUSTAT book value of stockholders' equity (data item 60), plus balance sheet deferred taxes (data item 74) and investment tax credits (data item 208) minus the book value of preferred stock. Depending on the availability of data, I use the redemption (data item 56), liquidation (data item 10), or par value (data item 130) of preferred stock. The book-to-market equity (BE/ME) is the book equity for the fiscal year ending in calendar year $t-1$ divided by market equity at the end of December of $t-1$. Negative or zero book values are treated as missing. I use further screening to satisfy the standard requirements in finance literature. The time period is from January 1965 to December 2015.

The debt to assets ratio, cash flows to assets ratio, operating profitability, investment to assets ratio is calculated using Compustat data. The debt to assets ratio is the total long-term debt (data item 142) plus total debt in current liabilities (data item 34) divided by total assets (data item 120). The cash flows to assets ratio is the income before extraordinary items (data item 18) plus depreciation and amortization (data item 133) divided by total assets. Following Novy-Marx (2013), I compute the operating profitability as the change in revenues minus cost of goods sold (data item 41) minus selling, general and administrative expense (data item 132), zero if missing, minus total interest and related expenses (data item 134), zero if missing, divided by the book equity for the fiscal year ending in calendar year $t-1$. The investment to assets ratio is the change in total assets divided by lag total assets.

I exclude the smallest and the largest market equity firms at 5 and 95 percent break points each year such that the tradable and the non-tradable portfolios have similar fundamental characteristics. I exclude foreign incorporated firms as they are likely to be more influenced by foreign trade policy than domestic trade policy. In order to exclude foreign incorporated firms and ADRs, I only include common stocks as identified by the CRSP share code (SHRCD) of 10 or 11. Trade induced productivity shocks are likely to impact firms operating in the U.S. Thus I only include firms with headquarters located in the U.S.

3.3.3. Trade Minus Non-tradable (TMN) Portfolio

Table 3.2 reports the composition of the tradable and the non-tradable goods sector portfolios. The sector producing tradable goods is larger compared to the sector producing non-tradable goods number of firms. However, the book-to-market equity ratio, market equity, debt-to-assets ratio, cash flows-to-assets ratio, operating profit and firm level investment are similar in terms of the median, the 10th percentile and the 90th percentile of the firms in tradable and non-tradable sectors. Thus firms in both portfolios have similar fundamentals except for the differences in tradability.

The novel measure of the trade induced productivity shock is the returns to the value-weighted portfolio long tradable good producers minus non-tradable good producers, the returns to the TMN portfolio. As shown in the real business cycle model, the value of the T-sector appreciates more relative to the N-sector in response to a positive shock to trade induced productivity change.

Figure 3.2 plots the TMN portfolio returns versus the change in real exports of goods and services two quarters ahead. The real export data is from the U.S. Bureau of Economic Analysis (BEA) database. I use a Hodrick–Prescott (HP) filter to remove the cyclical component of exports. The correlation between TMN portfolio returns at time t and the change in real exports at $t + 2$ is 0.23 and 0.30 for the post-war sample (1947-2016) and the post-compustat sample, respectively.

The positive shocks to the TMN portfolio returns correspond to some of the major news events regarding reductions in trade barriers and costs. For example, the third quarter positive shock in 1986 corresponds to the trade negotiations between the U.S. and Canada, which resulted in the *Canada–United States Free Trade Agreement*. The third quarter positive shock in 1990 corresponds to the trade negotiations between the U.S., Canada and Mexico, which later became the *North American Free Trade Agreement* (*NAFTA*). The third quarter positive shock in 2002 corresponds to the U.S. Senate granting authority to the U.S. President to negotiate a free trade agreement with Chile and a few other countries.

Table 3.3 presents a general look at the industry level exposure to the TMN portfolio returns and the industry exposure to the excess market returns. I employ the Fama and French 49 industries from Kenneth R. French's website. The industry exposure is the beta with respect to trade induced productivity change. I regress the returns of each industry against the TMN portfolio returns to determine its industry beta.[18] Some of the industries with strong exposure to the trade induced productivity shock include steel, fabricated products manufacturing, coal, computers, and auto industry. Industries with lower exposure to the trade induced productivity shock include food products, restaurants, hotels industry, retail, and healthcare. The low exposure for air craft and defence industries is expected because such industries are government regulated and are more likely to be affected by government spending shocks (Dissanayake (2017*a*)).

[18]This is equivalent to the Fama and MacBeth (1973) first stage procedure.

3.4. Macroeconomic Dynamics

In the previous section, I show that some of the positive shocks to the TMN portfolio returns correspond to news events regarding reductions in trade barriers and costs and that the TMN portfolio returns positively co-vary with real exports of goods and services. In this section, I formally validate the new measure of trade induced productivity shocks by exploring their macroeconomic dynamics. To do so, I examine impulse responses generated through the following Vector Autoregression (VAR),

$$X_t = A(L)X_{t-1} + \varepsilon_t, \tag{3.23}$$

where X_t is the vector of variables, $A(L)$ is a polynomial in the lag operator and ε_t is a vector of white-noise disturbances that may be correlated. For better accuracy, I use quarterly data, four lags of each variable and a linear time trend. I use a fixed set of variables and rotate in other variables of interest, one at a time. The fixed set of variables consists of the trade induced productivity shock approximated by the returns to the TMN portfolio, excess returns to the market portfolio, real exchange rate, log of real per capita exports, log of real per capita imports, log of real per capita GDP, and three-month T-bill rate. The macroeconomic variables are from the BEA database. The real effective exchange rate data is from the International Monetary Fund's International Financial Statistics database.

The quarterly TMN portfolio returns are compounded from monthly returns. The additional variables considered are the *terms of trade*, investment-specific technological (IST) change, marginal efficiency of investment (MEI), log of real per capita non-residential investment, log of real per capita non-durable consumption, durable consumption, and services consumption. The IST and MEI data are from the Justiniano, Primiceri, and Tambalotti (2011).

Figure 3.3 presents the orthogonalized impulse response functions and their corresponding 95 percent bootstrapped standard error bands. Response functions are normalized such that the maximum response of real exports to a positive TMN shock is equal to one. Exports significantly increase for eight quarters and peaks four quarters after the trade induced productivity shock. Imports increase in the short-run. However, the increase in imports is much lower in comparison to the increase in exports. Investment significantly increases in the short-term following a positive shock to trade induced productivity. Output rises in the short-run, though it is not significantly different from zero at conventional levels.

The *RBC* model predicts that a positive shock to trade induced productivity decreases the *terms of trade*. To disentangle whether the TMN portfolio returns capture foreign demand increase versus supply side productivity change shown in the model, I examine the dynamics of the relative price of exports in terms of price of imports, the *terms of trade*. An increase in supply side productivity would decrease the production cost of tradable goods, deteriorating the terms of trade. In contrast, a positive demand shock allow firms to increase production at a higher price, thus increasing the *terms of trade*. Figure 3.3 shows that the *terms of trade* significantly decreases following a positive shock to the TMN portfolio returns, implying that the novel measure captures mostly supply side productivity change. The decrease in the relative price of exports is partly in accordance with the literature that suggests trade liberalization lowers the average export price via a "pro-competitive" effect (Benigno and Thoenissen (2003)).

Recent literature finds that the impacts of technology and the impacts of trade are separable in the U.S. (Autor, Dorn, and Hanson (2013*b*)). Thus I examine the response of IST change and MEI following a positive shock to trade induced productivity. Both IST and MEI significantly increase following a positive shock to the TMN portfolio returns. This validates the use of correlated shocks in the RBC model.

The subsequent set of impulse response functions examines the implications of trade induced productivity change on consumption, which motivates the asset pricing implications. I examine the response of non-durable consumption and durable consumption to conjecture on the sign of the premium associated with the trade induced productivity change. For the case of households with late resolution of uncertainty, an increase (decrease) in durable and non-durable plus services consumption implies a positive (negative) price of risk for the trade induced productivity shock. All forms of consumption decrease in the short-term following a positive shock to the TMN portfolio returns. Non-durable consumption decreases less than durable consumption as a result of agent's preference to smooth non-durable consumption over time. The short-term decrease in consumption implies that trade induced productivity shocks are likely to be negatively priced in the cross section of asset returns.[19]

Literature finds that Chinese import competition contributed to the decrease in manufacturing employment (Autor, Dorn, and Hanson (2013*a*)), the increase in technical change within firms (Bloom, Draca, and Van Reenen (2016)), and the overall job losses in the U.S. (Acemoglu, Autor, Dorn, Hanson, and Price (2016)).[20] I explore

[19]Investors can smooth consumption by holding an asset that co-varies positively with the trade induced productivity shock.

[20]Acemoglu, Autor, Dorn, Hanson, and Price (2016) find that job losses resulting from Chinese import competition from 1999 to 2011 is in the range of 2.0 million to 2.4 million.

whether the TMN portfolio returns provide information beyond what is contained in innovations to Chinese import competition. To do so, I control for Chinese import competition in the VAR described in (3) by employing the time series Chinese import competition measure in Autor, Dorn, and Hanson (2013*a*). Given that the measure is available only at the yearly frequency, I use two lags of each variable and a quadratic time trend in the VAR.[21]

Figure 3.4 shows the impulse response functions to the trade induced productivity shock, controlling for Chinese import competition. The real per capita exports significantly increase following the positive shock to the TMN portfolio returns. Output significantly increases following the trade induced productivity shock, and much higher compared to figure 3.3 . This suggest that, in the case of limited import competition, there is evidence for the long term export led growth hypothesis. Chinese import competition significantly decreases following a positive shock to the TMN portfolio returns, implying that the TMN portfolio returns provide information beyond what is contained in the Chinese import competition measure.

3.5. The Pricing of Trade Induced Productivity Shocks

In the previous section, I show that a positive trade induced productivity shock decreases both durable and non-durable consumption. This implies that the trade induced productivity shock is systematic and is possibly priced in the cross section of equity returns. In this section, using a number of asset pricing tests, I examine whether trade induced productivity shocks are priced in the cross section of asset returns. The first set of tests includes portfolio sorting and the second set of tests includes cross sectional asset pricing tests.

[21]The results are robust to the use of four lags of each variable.

3.5.1. Exposure to the trade induced productivity shock

First, I construct a firm level measure of sensitivity to the trade induced productivity shock. I use the firm's stock return beta with respect to the TMN portfolio returns as the measure of firm's exposure to the trade induced productivity shock. I control for other sources of systematic risk in the economy by including the value weighted excess returns to the market portfolio, MKT. Specifically, for each firm i, I estimate the following time series regression,

$$r_{i,t} - r_{f,t} = \alpha_{i,t} + \beta_{i,t}^{MKT}\ r_t^{MKT} + \beta_{i,t}^{TMN}\ r_t^{TMN} + \epsilon_{i,t}, \tag{3.24}$$

where $t = 1, \dots, 120$, $r_{f,t}$ is the risk free rate, r_t^{MKT} is the excess returns to the market portfolio, and r_t^{TMN} is the returns to the TMN portfolio. I use a 120 month rolling window to estimate the $\beta_{i,t}^{MKT}$, $\beta_{i,t}^{IMC}$, and $\beta_{i,t}^{TMN}$. Following Fama and French (1992), I require at least 24 observations to be included in the sample.

3.5.2. Portfolio Sorting

I form the first set of test portfolios by sorting NYSE, AMEX, and NASDAQ stocks on β^{TMN}, the exposure to the trade induced productivity shock. Firms are sorted in to ten portfolios (deciles) by their sensitivity to the shock. In June of each year, all stocks are ranked by their β^{TMN}, and are then allocated to the TMN portfolio deciles based on the breakpoints.

Table 3.4 reports the characteristics of the portfolio deciles sorted by the exposure to the TMN portfolio returns. Rank L represents the lowest β^{TMN} portfolio (portfolio of firms with the lowest sensitivity to trade induced productivity change) and rank H the highest β^{TMN} portfolio (portfolio of firms with the highest sensitivity to trade induced productivity change). The β^{TMN} ranges from -2.04 to 1.34, capturing a sizable variation in sensitivity to the trade induced productivity shock.[22] The value-weighted excess returns generally decrease as the average β^{TMN} increases. The monthly value-weighted long-short portfolio return spread is -0.56 percent. This corresponds to an annual value-weighted long-short portfolio return spread of approximately -6.7 percent, which is comparable to the magnitude of the equity premium in the post-Compustat era.[23] The long-short value-weighted return spread is significant at the 5 percent level, where standard errors were adjusted using Newey and West (1987) procedure with lags up to 3 years.

Next, I explore whether the traditional CAPM betas can explain the portfolios sorted on the exposure to the trade induced productivity shock.[24] The results show that CAPM betas fail to price the portfolio returns. I also show that the monthly excess returns over the CAPM model, α_{CAPM}, and the monthly excess returns over a three-factor Fama and French (1993) model, α_{FF}, are negative and significant at the 10 percent level..

There is little variation in the book-to-market ratio across the TMN beta quintiles. Although not monotonic, the average firm's market equity within each portfolio increases as the exposure to trade induced productivity change increases. The results imply that firms with high exposure to the trade induced productivity shock are generally larger.

[22]Small variation in betas may lead to erroneously measured factor premiums.
[23]The equity premium is approximately 5.98 percent since July 1965.
[24]Capital Asset Pricing Model (CAPM) suggests that asset returns increase as their exposure to the excess market returns, measured by β^{MKT}, increases.

Barrot, Loualiche, and Sauvagnat (2016) find that manufacturing industries with low level shipping costs are more exposed to globalization.[25] For robustness, I examine whether the risk premium associated with the trade induced productivity shock varies with shipping costs. I find that the risk premium associated with the trade induced productivity change is negative for both high and low shipping costs industries.[26] However, the negative risk premium is much larger in magnitude for low shipping costs industries (-6.192%) in comparison to low shipping costs industries (-3.456%). The results suggest that the systematic risk associated with globalization effect via import competition is different from systematic risk associated with the globalization effect via trade induced productivity change, as explored in this study.

3.5.2.1. Two-way Portfolio Sorting. Literature suggests that larger plants are more likely to export in international markets (Verhoogen (2008), Bustos (2011)). Based on these findings, I formulate two hypotheses and investigate them empirically.

The first hypothesis I examine is on the relation between firm size and the risk premium associated with trade induced productivity change. I conjecture that larger firms are more likely to enter and compete in international markets compared to smaller firms, thus the negative premium is presumably greater in-terms of magnitude within such firms.

Table 3.5 reports summary statistics for 15 portfolios independently sorted on TMN beta and market equity. The results show that the average excess returns generally decrease with the TMN betas, controlling for market equity. Moreover, the negative long-short return spread associated with the trade induced productivity shock is strongest among the largest size tercile. Results support the hypothesis that

[25]Specifically, higher import competition.
[26]The results are reported in Appendix 2 .

the negative premium is greater within larger firms. I also find that the size premium is not significant controlling for TMN beta.

As a supplementary test, I examine the exposure to the trade induced productivity shock for ten portfolios (deciles) sorted on market equity. Figure 3.5 plots the TMN betas and MKT betas on the deciles sorted on market equity. The left panel shows that, in general, higher size portfolios have higher exposure to the trade induced productivity shock, consistent with the intuition that larger firms are more likely to compete in international markets relative to smaller firms. The portfolios with the higher excess returns have lower TMN betas, thus explaining the cross section of the deciles. However, as shown in the right panel, CAPM betas fail to price the size deciles.

The second hypothesis I examine is on the relation between firm investment and the risk premium associated with trade induced productivity change. I conjecture that more aggressive investment firms are more likely to endure larger fixed costs to compete in international product markets compared to more conservative investment firms. Thus, the negative premium is presumably greater in-terms of magnitude within more aggressive investment firms.

Table 3.6 reports summary statistics for the 15 portfolios independently sorted on TMN beta and investment, with a 36 month holding period. The results show that the magnitude of the negative TMN beta long-short portfolio returns is significant only within the medium and larger investment terciles. It is also noteworthy that returns monotonically decrease with the exposure to the trade induced productivity shock controlling for investment. For robustness, I perform the exact portfolios sorts but substituting investment-to-assets ratio with investment-to-capital (I/K) ratio. I find that the negative premium associated with the trade induced productivity shock is greater for high I/K ratio firms, as shown in Appendix 2 .

3.5.3. Cross Sectional Tests

In this section, I investigate whether trade induced productivity change is priced in the cross section of equity returns. I employ a Fama and MacBeth (1973) two-step procedure to perform asset-pricing tests.

3.5.3.1. The Tested Hypotheses. To test whether the risk associated with the trade induced productivity change is priced, I consider plausible empirical asset-pricing specifications in which the shock appears as a factor. It is unlikely that the trade induced productivity shock is the only factor that explains the entire cross section of asset returns. Thus, I consider the following empirical asset-pricing models:

$$R^e_{i,t} = \alpha + \beta^{MKT}\ R^e_{MKT,t} + \beta^{TMN} TMN_t + sSMB_t + hHMB_t + \epsilon_t, \tag{3.25}$$

$$R^e_{i,t} = \alpha + \beta^{MKT}\ R^e_{MKT,t} + \beta^{TMN} TMN_t + sSMB_t + hHMB_t + rRMW_t + cCMA_t + \epsilon_t, \tag{3.26}$$

$$R^e_{i,t} = \alpha + \beta^{MKT}\ R^e_{MKT,t} + \beta^{TMN} TMN_t + sSMB_t + hHMB_t + mMOM_t + \epsilon_t, \tag{3.27}$$

where $R^e_{i,t}$ represents the excess returns of the portfolio i at time t, SMB is the return on a diversified portfolio of small stocks minus the return on a diversified portfolio of big stocks, HML factor is the difference between the returns on diversified portfolios of high and low book equity to market equity stocks, RMW factor is the difference between the returns on diversified portfolios of stocks with robust and weak profitability, and CMA factor is the difference between the returns on diversified portfolios of the stocks of conservative and aggressive investment firms.[27] In (26), I augment the Fama and French (1993) three-factor model by incorporating the TMN portfolio returns. In (27), I augment the Fama and French (2015) five-factor model by incorporating the TMN portfolio returns. In (28), I augment the Carhart (1997) four-factor model by incorporating the TMN portfolio returns. I also present the results from the above two specifications without the trade induced productivity shock for comparison purposes.

3.5.3.2. Factor Correlations. Table 3.7 displays the correlations between the risk factors used in the cross sectional estimations and their corresponding statistical significance. The TMN portfolio returns have a low correlation with all of the commonly used factors in empirical asset pricing literature. This suggests that the TMN portfolio returns capture risk not captured by each of the other factors. Although small in magnitude, the negative correlation between the trade induced productivity shock and the size premium, proxied by SMB, and the profitability premium, proxied by RMW, is statistically significant.

3.5.3.3. Cross Sectional Results. Table 3.8 presents the Fama and MacBeth (1973) risk premium estimations. I use a large panel of 80 portfolios: the test assets include 15 value-weighted portfolios sorted on β^{TMN} and size, 15 value-weighted portfolios sorted on β^{TMN} and investment, 25 value-weighted portfolios sorted on BE/ME and size, and 25 value-weighted portfolios sorted on investment and operating profitability. I choose these portfolios as the test assets because they exhibit a high dispersion of TMN betas.

[27]All factors except for the TMN portfolio returns are from Kenneth R. French's website.

The first specification shows the factor premiums for the Fama and French (1993) three-factor model. Only the value premium is significant in the model. The second specification shows the model described in 3.25 . The trade induced productivity shock is negatively priced in the cross section and is statistically significant at the 5 percent level. The value factor remains significant, however, only at the 10 percent level. The third specification shows the factor premiums for the Fama and French (2015) five-factor model. Here, both investment and profitability are statistically significant. The specification (IV) shows the model in 3.26 . The trade induced productivity shock remains negatively priced and statistically significant. The investment factor remains significant at the 5 percent level and profitability at the 10 percent level. The specification (IV) shows the Carhart (1997) four-factor model. The momentum factor is positively priced and is significant at the 5 percent level. The value premium is significant only at the 10 percent level. The final specification shows the model in 3.27 .

Overall, the results show that trade induced productivity change is negatively priced in the cross section of equity returns and is robust to the inclusion of a number of factors. The TMN factor is negatively priced in this specification. The monthly risk premium ranges from -0.37 percent to -0.44 percent, which is similar in magnitude to the long-short portfolio return spread reported in Table 3.4 . The results are consistent with trade induced productivity change causing high marginal utility of wealth states.

3.6. Conclusion

I propose a novel measure of trade induced productivity change using financial data, and examine the effect that trade induced productivity shocks may have on equity returns. The novel measure proposed is the returns to the portfolio long firms producing tradable goods minus firms producing non-tradable goods, the returns to the TMN portfolio. Sizable shocks to the TMN portfolio returns correspond to trade negotiations such as the discussions that lead to the *North American Free Trade Agreement* (NAFTA), which resulted in reduced trade barriers and costs for many tradable good producers.

I show that, in the short-run, durable consumption and non-durable plus services consumption decrease following a positive shock to trade induced productivity. Assets with high exposure to the trade induced productivity shock deliver high returns during high marginal utility of wealth states. Investors are willing to accept lower expected returns to hold assets with high exposure to trade induced productivity shock as such assets provide a hedge against consumption risk.

I provide evidence that trade induced productivity shocks is a priced factor. Asset pricing tests show that the trade induced productivity change is negatively priced in the cross section of equity returns, and the premium is robust to the inclusion of multitude of other factors. I find that the negative risk premium is stronger within larger firms and high investment firms.

I also find weak evidence for the export led growth hypothesis. However, controlling for Chinese import competition measure, output significantly increases following a positive trade induced productivity shock.

Table 3.1. Parameters used for benchmark caliration

Parameter	Symbol	Value
Preferences		
Subjective discount factor	β	0.985
Relative risk aversion (RRA)	γ	1.1
Elasticity of intertemporal substitution (EIS)	Ψ	0.67
Degree of labor disutility	ψ	2.8
Sensitivity of labor disutility	θ	1.4
Production		
Investment adjustment cost in T-sector	ϕ_N	1.1
Investment adjustment cost in N-sector	ϕ_T	0.7
Capital depreciation rate	δ	8.5%
Capital share in N-sector and T-sector	β_T,β_N	0.36
Import share parameter	χ	0.65
Intratemporal elasticity of substitution of T-goods and M-goods	μ	0.82
Shocks		
Standard deviation of A-shock	σ^a	1%
Standard deviation of Z-shock	σ^z	1%
Persistency of long-run risk for A-shock and Z-shock	ρ_{μ_a},ρ_{μ_a}	0.67
Standard deviation of A-shock and Z-shock	σ^{μ^a},σ^{μ^Z}	1%
Standard deviation of MEI-shock	σ^{MEI}	2%
Persistency of MEI-shock	ρ_{MEI}	0.67
Correlation between Z and μ^{MEI}	$\rho_{Z,\mu}$	0.3

This table presents the parameters used for the benchmark calibration for the real business cycle model in section 3.2 .

Table 3.2. Tradable minus Non-tradable Portfolio Composition

	Tradable			Non-Tradable		
	Median	10%	90%	Median	10%	90%
Market Capitalization	0.273	0.028	3.243	0.304	0.028	3.880
Book-to-Market Equity	0.651	0.217	1.479	0.601	0.206	1.422
Debt to Assets	0.246	0.009	0.472	0.255	0.020	0.532
Cashflow to Assets	0.090	0.030	0.163	0.091	0.032	0.167
Operating Profit	0.112	-0.031	0.225	0.121	-0.007	0.232
Investment	0.075	-0.057	0.328	0.087	-0.056	0.361
Number of firms		858.3			182.2	

This table reports the portfolio composition of firms in the Tradable Sector and the Non-tradable sector. I report market equity (in thousands), book-to-market equity, debt to assets ratio (Compustat item dltt plus item dlc divided item at), cash flows to assets ratio (Compustat item ib plus item dp divided by item at), operating profitability (Compustat item revt minus item cogs minus XSGA, zero if missing, minus XINT, zero if missing, divided by book equity for the fiscal year ending in calendar year t-1) and investment to assets ratio (change in Compustat item at divided by lag item at). I provide the time-series averages of the median and the 10 percent and the 90 percent deciles within each portfolio. The sample includes data from July 1947 to December 2016.

Table 3.3. Industry Exposure to the Trade Induced Productivity Shock

Industry Classification	β_t^{TMN}	β_t^{MKT}
Fabricated Products	1.499	1.211
Steel Works	1.323	1.425
Precious Metals	1.242	0.724
Real Estate	1.222	1.310
Consumer Goods	0.762	0.892
Coal	0.692	1.220
Computers	0.659	1.298
Toys and Recreation	0.440	1.184
Automobiles and Trucks	0.434	1.197
Machinery	0.307	1.250
Non-Metallic and Industrial Metal Mining	0.235	1.118
⋮	⋮	
Beer & Liquor	-0.672	0.691
Retail	-0.690	0.959
Restaurants, Hotels, Motels	-0.722	0.957
Textiles	-0.793	1.068
Food Products	-0.842	0.584
Apparel	-1.252	0.997
Aircraft	-1.399	0.949
Entertainment	-1.480	1.182
Defense	-1.595	0.595
Healthcare	-1.670	0.912
Tobacco Products	-1.926	0.457

This table reports the industry level exposure to the trade induced productivity shock. The industry (Fama and French 49 Industry Portfolios) returns are from Kenneth R. French's website. β_t^{TMN} is the industry exposure to the trade induced productivity shock.

Table 3.4. Portfolios Sorted on TMN beta

β^{TMN}	L	2	3	4	5	6	7	8	9	H	H-L
Value-weighted returns											
Mean excess return	0.836	0.700	0.696	0.752	0.608	0.628	0.541	0.503	0.450	0.281	-0.555
(t-stat)	(3.32)	(3.28)	(3.53)	(4.03)	(3.33)	(3.81)	(3.30)	(3.07)	(2.37)	(1.14)	(-2.68)
α_{CAPM}	0.165	0.102	0.142	0.219	0.083	0.149	0.060	0.030	-0.072	-0.326	-0.492
(t-stat)	(1.17)	(0.97)	(1.52)	(2.82)	(1.29)	(2.47)	(0.98)	(0.44)	(-0.63)	(-1.72)	(-1.94)
α_{FF}	0.095	0.070	0.081	0.243	0.086	0.149	0.035	0.070	-0.041	-0.294	-0.388
(t-stat)	(0.80)	(0.74)	(0.87)	(3.20)	(1.18)	(2.71)	(0.62)	(0.96)	(-0.41)	(-1.61)	(-1.76)
Characteristics											
β^{TMN}	-2.037	-1.126	-0.786	-0.555	-0.366	-0.194	-0.018	0.186	0.493	1.351	
β^{MKT}	1.240	1.129	1.067	1.032	1.019	1.002	1.007	1.063	1.186	1.440	
BE/ME	0.733	0.848	0.824	0.851	0.852	0.850	0.870	0.854	0.823	0.762	
Size	0.557	0.785	0.992	1.372	1.600	2.348	2.651	2.376	1.963	1.103	

The table reports the time series averages of the value-weighted excess returns for portfolios sorted on the exposure to the trade induced productivity shock. The t-statistics for the return spreads are reported in parentheses using Newey and West (1987) standard errors, allowing lags up to 3 years. "H-L" is the return difference between the highest and lowest TMN portfolio. I also report the monthly excess returns (α_{CAPM}) over the CAPM model and the monthly excess returns (α_{FF}) over a three-factor Fama-French model of weight-to-value portfolios. The exposure to the trade induced productivity shock , β^{TMN}, and the exposure to the excess returns on the market portfolio, β^{MKT}, are computed by estimating the regression in equation 3.24 , using the prior 120 months of data. I also report the average book equity to market equity (BE/ME) ratio and market equity (Size). The sample includes data from July 1947 to December 2016.

Table 3.5. Portfolios sorted on TMN beta and Size

a) Excess Returns

	β^{TMN} L	2	3	4	H	H-L	(t-stat)
S	0.954	0.988	1.031	0.860	0.604	-0.350	(-1.59)
2	0.887	0.932	0.837	0.785	0.584	-0.303	(-1.44)
B	0.909	0.741	0.597	0.462	0.355	-0.554	(-2.37)
S-B	0.045	0.247	0.434	0.398	0.249		
(t-stat)	(0.17)	(0.99)	(1.75)	(1.76)	(0.83)		

b) β^{TMN}

	β^{TMN} L	2	3	4	H
S	-1.822	-0.771	-0.349	0.046	1.070
2	-1.619	-0.761	-0.349	0.042	0.881
B	-1.489	-0.747	-0.335	0.057	0.794

c) Market Equity

	β^{TMN} L	2	3	4	H
S	0.115	0.119	0.118	0.106	0.102
2	0.955	0.995	0.997	1.046	1.048
B	7.124	9.873	13.229	15.803	10.921

d) BE/ME

	β^{TMN} L	2	3	4	H
S	0.873	0.986	1.025	0.941	0.807
2	0.579	0.654	0.689	0.762	0.682
B	0.452	0.533	0.551	0.643	0.683

The table reports summary statistics of the value-weighted excess returns for portfolios independently sorted on the exposure to the trade induced productivity shock and Market Equity (Size). The t-statistics are reported in parentheses using Newey and West (1987) standard errors, allowing lags up to 3 years. “High-Low” is the return difference between the highest and lowest TMN portfolios within each size tercile. The exposure to the trade induced productivity shock , β^{TMN}, and the exposure to the excess returns on the market portfolio, β^{MKT}, are computed by estimating the regression in equation 3.24 , using the prior 120 months of data. The sample includes data from July 1963 to December 2016.

Table 3.6. Portfolios sorted on TMN beta and Investment

a) Excess Returns

	β^{TMN}						
	L	2	3	4	H	H-L	(t-stat)
1	0.912	0.988	0.835	0.715	0.674	-0.238	(-1.35)
2	0.964	0.746	0.606	0.540	0.467	-0.497	(-3.25)
3	0.801	0.744	0.555	0.532	0.314	-0.487	(-2.27)
3 m 1	-0.111	-0.244	-0.279	-0.183	-0.361		
(t-stat)	(-0.60)	(-1.66)	(-1.88)	(-1.30)	(-1.88)		

b) β^{TMN}

	β^{TMN}				
	L	2	3	4	H
1	-1.827	-0.767	-0.350	0.043	1.021
2	-1.671	-0.762	-0.348	0.041	0.815
3	-1.761	-0.775	-0.349	0.046	1.005

c) Market Equity

	β^{TMN}				
	L	2	3	4	H
1	0.434	0.707	1.574	2.009	1.126
2	1.041	1.692	2.978	3.983	2.967
3	1.029	1.970	2.472	3.631	1.975

d) BE/ME

	β^{TMN}				
	L	2	3	4	H
1	0.960	1.038	1.024	0.956	0.831
2	0.917	0.906	0.882	0.862	0.783
3	0.537	0.659	0.676	0.669	0.585

The table reports summary statistics of the value-weighted excess returns for portfolios independently sorted on the exposure to the trade induced productivity shock and Investment-to-assets ratio. Investment-to-assets ratio is the change in Compustat item at divided by lag item at. The t-statistics are reported in parentheses using Newey and West (1987) standard errors, allowing lags up to 3 years. "High-Low" is the return difference between the highest and lowest TMN portfolios within each investment tercile. The exposure to the trade induced productivity shock , β^{TMN}, and the exposure to the excess returns on the market portfolio, β^{MKT}, are computed by estimating the regression in equation 3.24 , using the prior 120 months of data. The sample includes data from July 1963 to December 2016.

Table 3.7. Risk Factor Correlations

Factors	TMN	MKT	SMB	HML	RMW	CMA	MOM
TMN	1.0000						
MKT	-0.1582**	1.0000					
SMB	-0.3143**	0.2834**	1.0000				
HML	-0.0200	-0.3043**	-0.1216**	1.0000			
RMW	-0.2592**	-0.2076**	-0.3642**	0.0896**	1.0000		
CMA	0.0668	-0.3936**	-0.1196**	0.7029**	-0.0834**	1.0000	
MOM	0.1407**	-0.1281**	-0.0216	-0.1585**	0.0955**	0.0021	1.0000

The table reports the correlation, measure the strength and direction of the linear relationship, between the risk factors used in this study. TMN is the returns to the Tradable minus Non-tradable (TMN) portfolio. MKT is the excess returns on the value-weighted market portfolio, SMB is the portfolios of small stocks minus big stocks, HML is the difference between the portfolios high and low book-to-market stocks, RMW is the difference between the returns on portfolios of stocks with robust and weak profitability, and CMA is the difference between the returns on portfolios of low and high investment stocks. MOM is the momentum factor, STR is the short term reversal factor and LTR is the long term reversal factor. The sample includes monthly data from July 1963 to December 2016. Statistical significance at the 5%, and 10% levels are indicated by **, and *, respectively.

Table 3.8. Estimation of Competing Asset-Pricing Models

Factor	(I)	(II)	(III)	(IV)	(V)	(VI)
MKT	-0.264	-0.529	0.064	-0.060	0.445	-0.191
	(-0.70)	(-1.37)	(0.16)	(-0.14)	(0.93)	(-0.49)
TMN		-0.442**		-0.418**		-0.367**
		(-2.37)		(-2.17)		(-1.97)
SMB	0.236	0.247	0.286	0.270	0.245	0.250
	(1.23)	(1.27)	(1.46)	(1.39)	(1.21)	(1.28)
HML	0.392**	0.366*	0.265	0.271	0.387*	0.366
	(2.03)	(1.88)	(1.36)	(1.40)	(1.90)	(1.88)
RMW			0.323**	0.253*		
			(1.99)	(1.71)		
CMA			0.289**	0.320**		
			(2.14)	(2.44)		
MOM					1.701**	0.692
					(2.54)	(1.54)
MAPE	1.424	1.309	1.310	1.249	1.380	1.281

This table reports the Fama and MacBeth (1973) two-pass regression estimates and the mean absolute pricing errors (MAPE). The tests are performed on the excess returns of the 15 value-weighted portfolios sorted on TMN beta and Size, 15 value-weighted portfolios sorted on TMN beta and Investment, 25 value-weighted portfolios sorted on BE/ME and Size, and 25 value-weighted portfolios sorted on Investment and Operating Profitability. The t-statistics are reported in parentheses using Shanken (1992) corrections. TMN is the returns to the Tradable minus Non-tradable portfolio. MKT is the excess returns on the value-weighted market portfolio, SMB is the portfolios of small stocks minus big stocks, HML is the difference between the portfolios high and low book-to-market stocks, RMW is the difference between the returns on portfolios of stocks with robust and weak profitability, and CMA is the difference between the returns on portfolios of low and high investment stocks, and MOM is the monthly momentum factor. The sample includes monthly data from July 1963 to December 2016. Statistical significance at the 5% and 10% levels are indicated by ** and *, respectively.

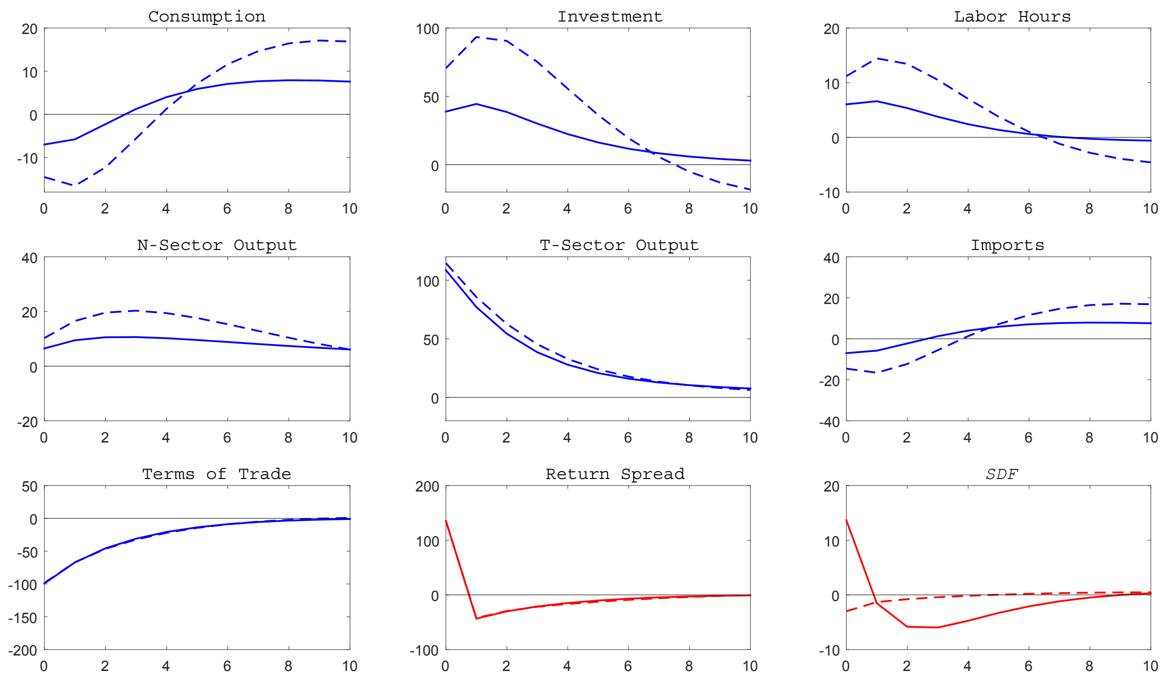


Figure 3.1. Simulated Responses to Trade Induced Productivity Shock

The figure plots the model responses of macroeconomic variables to a positive trade induced productivity shock. Specifically, the figure shows log-deviations from the steady-state. All the parameters are calibrated to the values reported in Table 1. The solid lines represent the case of late resolution of uncertainty *(RRA > 1/EIS)* and the dashed lines represent the case of early resolution of uncertainty *(1/RRA > EIS)*.

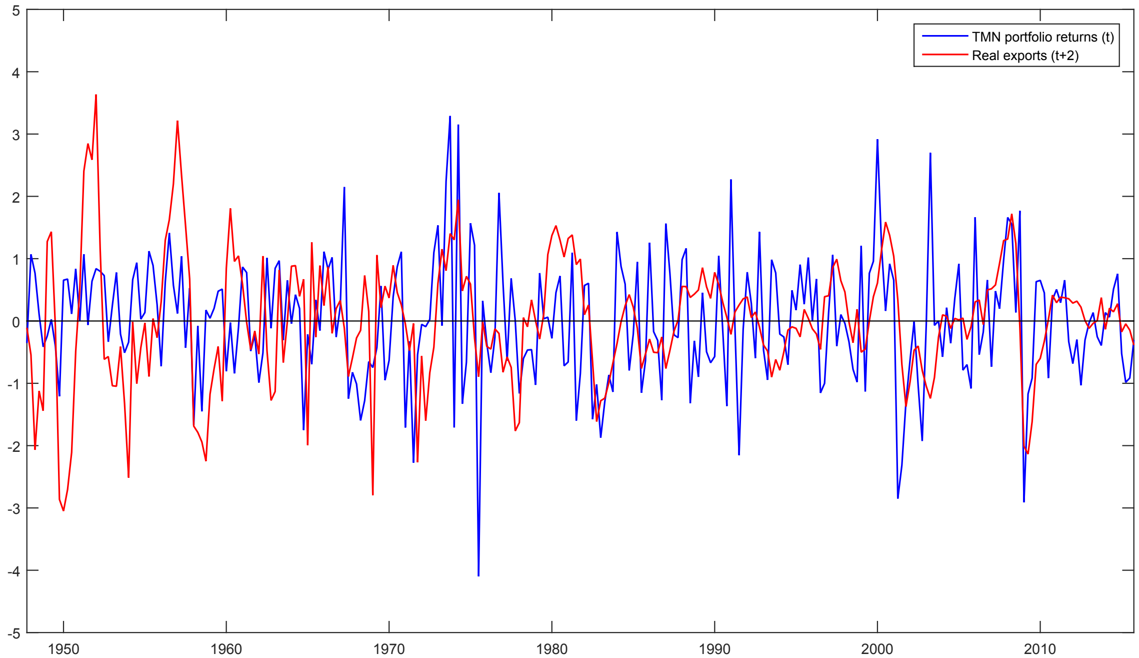


Figure 3.2. Returns to the TMN portfolio versus the change in real exports

The figure plots the TMN portfolio returns at time t versus the per capita real export at time t+2, where time is in quarterly frequency. I de-trend the export data using a Hodrick–Prescott filter with a smoothing parameter of 1,600 to remove the cyclical components. The returns to the TMN portfolio is the returns to the long-short portfolio of tradable minus non-tradable good firms. The sample covers the post war time period from 1947 to 2016.

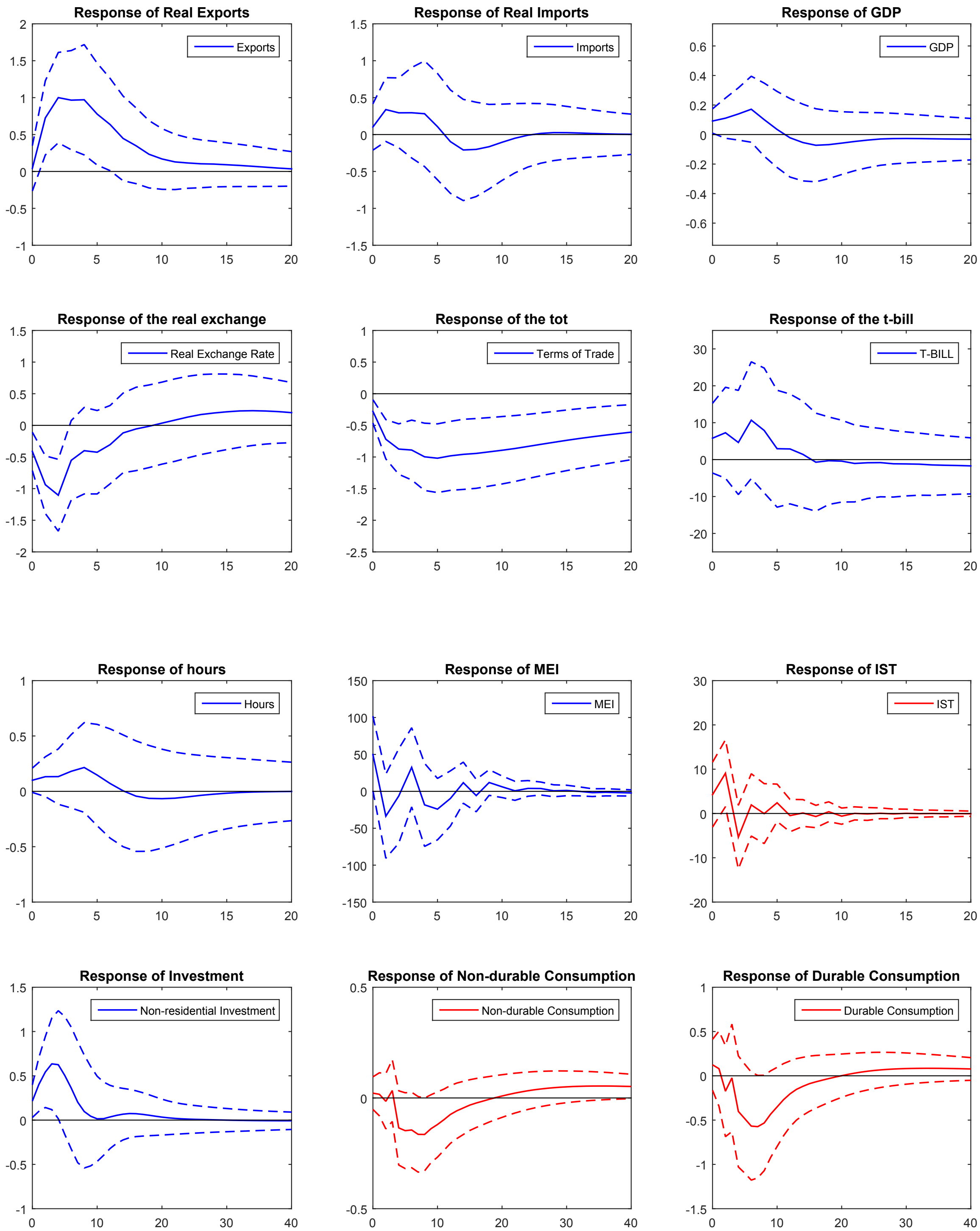


Figure 3.3. Macroeconomic Responses to a Positive Trade Induced Productivity Shock

The figure shows the orthogonalized impulse response functions to a positive shock to the TMN portfolio returns generated through the Vector Autoregression in equation 3.23 . The dotted lines represent 95% bootstrapped standard error bands. The sample includes quarterly data from 1947 to 2016.

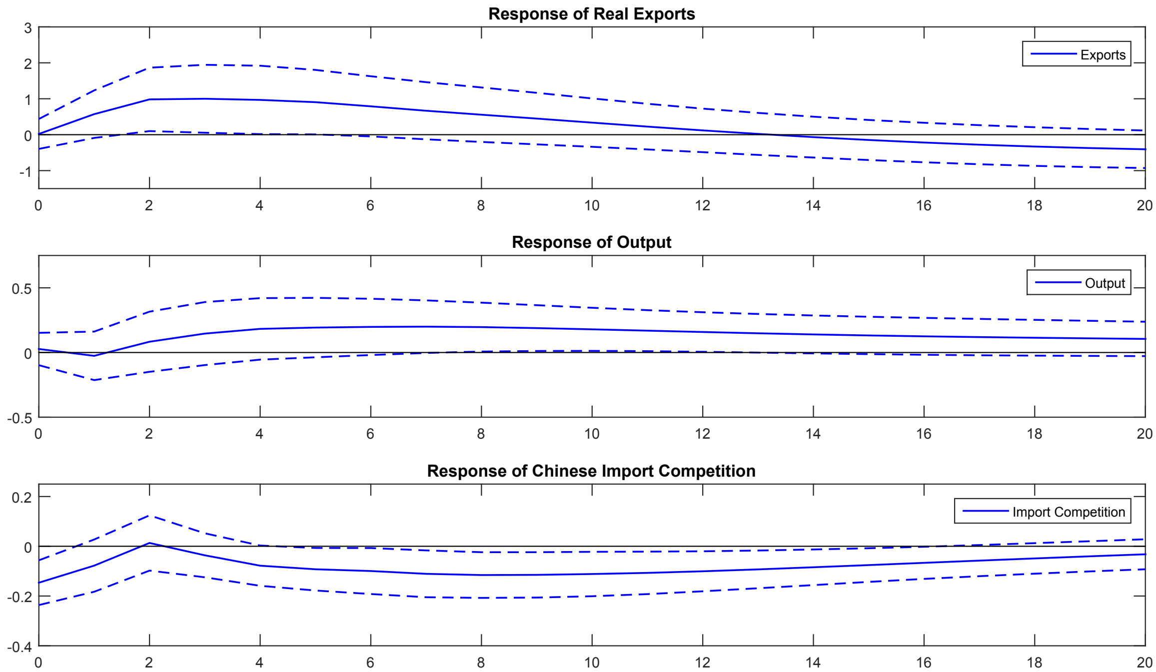


Figure 3.4. Responses to Trade Induced Productivity Change, Controlling for Chinese Imports Competition

The figure shows the orthogonalized impulse response functions to a positive shock to the TMN portfolio returns generated through the Vector Autoregression in equation 3.23 . The dotted lines represent 95% bootstrapped standard error bands. The macroeconomic variables are from the U.S. Bureau of Economic Analysis. The Chinese import competition data is from Autor, Dorn, and Hanson (2013*a*). The sample includes data from 1987 to 2007.

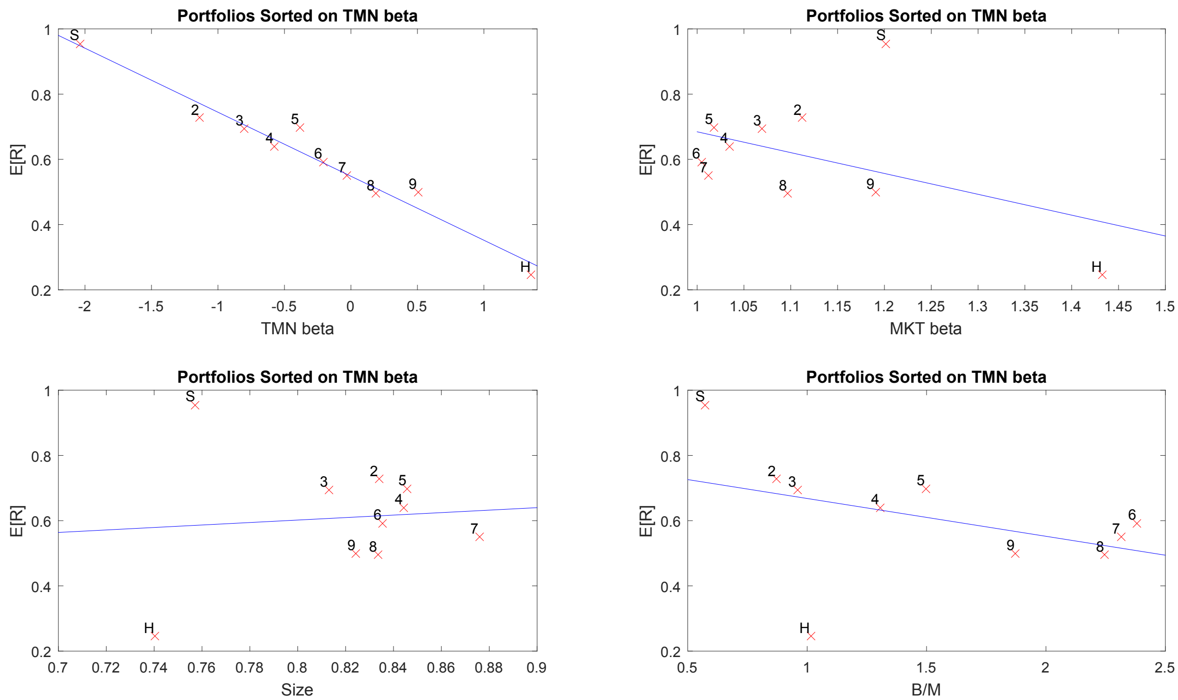


Figure 3.5. Portfolio Deciles Sorted on Market Equity

The figure plots average excess returns for 10 portfolios (Deciles) sorted on firms size. The left panel shows the average firm exposure to the trade induced productivity shock (β^{TMN}) and the right panel shows the average firm sensitivity to excess returns on the market portfolio (β^{MKT}). The exposure to the trade induced productivity shock , $\beta^{TMN}$and the exposure to the excess returns on the market portfolio, β^{MKT}, are computed by estimating the regression in equation (4), using the prior 60 months of data. The sample includes data from July 1965 to June 2015.

CHAPTER 4

Investment Shocks and Asset Returns: International Evidence

Technological innovation through the formation of new capital stock promotes economic growth. Firms allocate resources to efficiently produce output, from which households derive utility. Real investment thus affects the households' consumption stream and hence their pricing of claims to the firms' output. Despite this clear link between macroeconomy and finance, researchers have not agreed on the implied pricing relation. We find that pricing crucially depends on the availability of financial institutions, access to capital, and product market competition using a panel of firms from developed and emerging markets.

Most recent literature casts the above macroeconomics-finance nexus in tightly restricted general equilibrium and still reaches different conclusions. The disagreement originates in modeling differences that ultimately associate investment-specific technological (IST) shocks with either an increase (see, for e.g., Papanikolaou (2011), Kogan and Papanikolaou (2014), Kogan, Papanikolaou, and Stoffman (2013)) or a decrease (see, for e.g., Garlappi and Song (2016*a*), Li, Li, and Yu, (2017)) in marginal utility. The former implies a negative premium of investment shocks, while the latter does a positive premium. Interestingly, each of these opposing views is supported by empirical evidence. Using U.S. post-Compustat data from 1963, Papanikolaou (2011) and Kogan, Papanikolaou, and Stoffman (2013) estimate negative premiums on investment shocks. In contrast, using longer, post-1930 data, Garlappi and Song

(2016*b*) and Li (2017) report results consistent with positive premiums in the U.S. market. The contrast in conclusion within a single market is striking. The key to reconciling the empirical discrepancy appears to be the sample period. In fact, Garlappi and Song (2016*b*) confirm a negative investment premium if they use the post-1963 period. This suggests the possibility that the pricing of investment shocks is positive in an early stage of an economy and turns negative as it matures.

Motivated by this observation, we examine the pricing of investment-specific technological innovations by expanding the cross section of economies, rather than the sample period, to seek heterogeneity in economic stages. Specifically, we employ a large sample of firms from 33 countries. Given the economic heterogeneity, we expect to estimate a range of investment-shock premiums, which we seek to explain by country characteristics. This allows us to potentially identify the pricing mechanisms that are unmodeled in the theoretical literature. Thus, we aim to conduct not only an out-of-sample test of existing theory, but also an empirical exploration into new theory.

Following Papanikolaou (2011), we construct a mimicking portfolio for investment-specific technology shocks as the one long investment-good producers and short consumption-good producers. We choose this framework as it closely follows the literature in which the debate on investment-shock pricing arises. Despite a potential concern about data limitation, it turns out that necessary data for variable construction are available for a wide range of countries. We examine the pricing of the investment shock-mimicking factor in both time series and cross section. The former is the time-series mean of the monthly return spread between two extreme factor-beta sorted portfolios, while the latter is the cross-sectional premium on the factor estimated from a one-step GMM procedure. For robustness, we estimate these premiums in both equally and value-weighted bases, and in both the local and U.S. currencies.

Our contributions are threefold. First, as expected, we find a spectrum of investment-shock premiums ranging in both magnitude and sign, with more prevalence on the negative side. About two-thirds of sample countries exhibit negative investment-shock premiums in both time series and cross section, regardless of weighting or currency of measurement. Several of them, mostly developed countries, have significantly negative premiums. There are also a few countries with significantly positive premiums, all from emerging markets. Thus, significantly negative estimates tend to be observed in more mature markets, and positive ones in less mature markets. This is consistent with the aforementioned evidence from the U.S. market using recent and earlier periods, respectively.

The second contribution of our analysis is to identify the determinants of investment-shock pricing. Motivated by the contrast between the developed and emerging markets, we explore country characteristics that spread investment shock premiums. Through a series of cross-country regressions, we find that access to capital, access to financial institutions, and product market competition are the three main drivers of investment-shock pricing. Specifically, the negative pricing of investment risk is stronger in countries with greater access to capital, better financial institutions, and higher product market competition. We introduce a country level composite index that captures the overall efficiency in the aforementioned characteristics which determines the degree of IST-shock pricing.

Our third contribution is to scrutinize the link between the investment effect and the value effect documented in the U.S. market (Xing (2008)). Since the value effect is prevalent in international markets as well, our cross-country setting offers a natural laboratory to address this issue. We find that the investment effect is associated with, but not subsumed in, the global value effect. The relation between negative investment pricing and its three key determinants is robust to controlling for the value premium. Taken together, our results underscore the role that the three country characteristics play in the pricing of risk inherent in investment-specific technological innovations.

The importance of real investment for economic growth has been extensively studied in macroeconomics. The literature defines investment shocks as technological innovations, which are implemented through formation of new capital stocks. Investment shocks have been found to account for the majority of long-run economic growth and affect investment opportunities (Solow (1960), Hulten (1992), Greenwood, Hercowitz, and Krusell (2000), and Cummins and Violante (2002)). Using the quality-adjusted investment-good price as a proxy, Greenwood, Hercowitz, and Krusell (1997) find that IST shocks explain approximately 60 percent of the long-run growth in U.S. Fisher (2006) shows that IST shocks, along with neutral technology shocks which affect the production of all firms in a similar manner, account for the majority of production and employment variations in the U.S. Justiniano, Primiceri, and Tambalotti (2011) further claim that investment shocks are the most important source of the U.S. business cycle fluctuations. All such findings imply that real investment has a material consequence on aggregate welfare.

Our study builds on the macro-finance literature that takes the resulting pricing implications seriously. The theoretical disagreement mentioned above reflects the different views on how investment shocks affect household welfare. Connecting to the production-based asset pricing literature (Cochrane (1996)), Papanikolaou (2011) shows in general equilibrium that households' marginal utility rises as the economy reallocates resources away from the production of consumption goods toward investment goods, if the households have preference toward later resolution of uncertainty, or more specifically, sufficiently low risk aversion and low elasticity of intertemporal substitution. Intuitively, such investors are more concerned about smoothing consumption over time than across states. They would prefer assets that do well when investment sacrifices current consumption for improved future consumption. Such assets require low expected returns to clear their markets, leading to a negative premium on investment shocks. Kogan, Papanikolaou, and Stoffman (2013) further find that investment-specific technology innovations indeed carry a negative premium under a more relaxed assumption about household utility.

It is possible to mitigate or even reverse the trade-off between investment and consumption. Garlappi and Song (2016*a*) theoretically show that consumption can increase, rather than decrease, upon a positive investment shock if firms can optimally increase their capital utilization. Backing out latent factors from a dynamic stochastic general equilibrium model, Li, Li, and Yu, (2017) estimate a reliably positive premium for investment-specific technology shocks. They provide optimal capital utilization as a potential explanation for their finding. In an effort to simultaneously rationalize momentum profits and the value premium, Li (2017) estimates a negative premium for the relative price of investment goods to nondurable consumption goods. This is consistent with investment-specific technology shocks carrying a positive premium if the price is subject to supply pressure. Our study offers another piece of evidence for positive pricing from a development perspective.

The rest of the paper is organized as follows. The next section discusses data and methodology, and quantifies global investment-shock premiums in both time series and the cross section. Section 4.2 explores the determinants of pricing via a cross-country analysis, and demonstrates their robustness against the value effect. The last section concludes.

4.1. Pricing of Investment Shocks in International Markets

4.1.1. Data and Methodology

The primary variable of interest is the return on the mimicking portfolio of IST shocks. Following Papanikolaou (2011) and Gomes, Kogan, and Yogo (2009), we classify industries into investment- and consumption-good producers based on the input-output table for each country. The details can be found in Appendix 3. We choose this methodology as it turns out that all the necessary data for construction are available for a wide range of countries. We exclude financial and utility firms and require a country to have at least three consumption good producers and three investment good producers among firms in the national market.

At the end of each June, the mimicking portfolio goes long investment good producers and short consumption good producers within each country. Each side of the positions is value weighted, and returns are measured monthly from July to next June. The mimicking portfolio return is given by the spread between the returns on investment and consumption good producers, and hence dubbed the investment-minus-consumption (IMC) factor.

The data on stock market variables, such as the return index and market capitalization, are obtained from Thomson-Reuters Datastream. We supplement this data by Worldscope to collect accounting information and industry classification codes. To ensure the quality of the return data, we apply the screening proposed by Ince and Porter (2006) and treat returns above 300% that are reversed within one month as missing.[1] Following recent international finance literature (see, for e.g., McLean, Pontiff, and Watanabe (2009); Watanabe, Xu, Yao, and Yu (2013)), we also winsorize all the Datastream and Worldscope variables at the top and bottom one percentiles of their distributions within each country to eliminate the effect of outliers. For accuracy, we only use years in which a country has at least 50 stocks available.

Table 4.1 reports the descriptive statistics of our data. The sample covers 33 countries and spans varying periods between July 1982 and June 2014. In all countries but two (Denmark and Sweden), there are more consumption good producers (#Cons) than investment good producers (#Inv), resulting in the ratio of the number of firms in the former category to the latter larger than 1. The average IMC premium varies in both sign and magnitude, as intended. The real investment (INV) and real gross domestic product (GDP) per capita also show a large dispersion across countries, indicating economic heterogeneity.

4.1.2. Characteristics of Investment-shock Factor

As a preliminary examination of the investment-shock factor, IMC, Table 4.2 reports the correlation between IMC and the market (MKT), value (HML), and size

[1] Specifically, if r_t and r_{t-1} are the returns in months t and $t-1$, respectively, we set both to missing if either is greater than 300% and $(1+r_t)(1+r_{t-1})-1 < 50\%$.

(SMB) factors measured in local currency at the country level. MKT is the return on the country total return index from Datastream. SMB and HML are the size and value factors, respectively, constructed similarly to Fama and French (1993) by two-way independent sorts of individual stocks on market capitalization and the book-to-market ratio at the end of each June.

Out of the 33 countries, 21 have positive correlations between IMC and MKT ("# $>$ 0"), 15 of which are significant at the 10% level ("# $>$ 0, signif."). In contrast, of the remaining 12 countries with negative correlations ("# $<$ 0"), only 5 exhibit significantly negative ones ("# $<$ 0, signif."). Similarly, 20 countries have positive correlations between IMC and HML, of which 11 are significant, while 9 of the remaining 13 countries exhibit a significantly negative correlation. Finally, 26 countries have positive correlations between IMC and SMB, of which 16 are significant, while only 1 of the remaining 7 countries exhibit a significantly negative correlation. This suggests that IMC is unlikely to be subsumed in any of the standard three factors. We will return to this point in Section 4.2.3 where we investigate the relation between the investment and value effects.

To examine the appropriateness of the returns to the IMC portfolio as a proxy for investment specific technological change more formally, we follow Papanikolaou (2011) and estimate dynamic responses of real per capita investment and real per capita output to the IMC factor. Specifically, we estimate

$$\frac{1}{1+k}(x_{i,t+k} - x_{i,t-1}) = \alpha_0 + \beta_k R^{imc}_{i,t} + \gamma \Gamma_{i,t} + \epsilon_{i,t+k}, \qquad k = 0, \ldots, K, \tag{4.1}$$

where i denotes the country, x denotes the log value of the predicted variable, $R_{imc,t}$ denotes the return spread between investment and consumption good producers, and

Γ is a vector of controls, which includes the lag value of log x. We estimate the local projections for the pooled sample of developed countries and emerging markets at quarterly frequency. We examine the responses up to $K = 20$ quarters ahead. The standard errors are corrected for heteroscedasticity and serial correlation using the Newey and West (1987) procedure. Figures 4.3 and 4.3 depict the results. While investment increases for both panels, the response in greater in magnitude for developed countries. The increase in investment and output are significant at the conventional levels for only developed markets.

These results suggest that our sample encompasses economies with a spectrum of investment effects on output. If an investment shock does not increase the output in the short term, this likely entails an offsetting decrease in other components of the GDP. If it sacrifices consumption rather than government spending or net export (neither of which is modeled in any of the papers reviewed in the introduction), the environment is consistent with Papanikolaou's assumptions. Otherwise, a competing story such as optimal capital utilization (Garlappi and Song (2016*a*)) and other unmodeled mechanisms would become relevant.

4.1.3. Country-Level Pricing of Investment-shock Factor

In this section, we examine the pricing of the investment-specific technology shocks proxied by the IMC factor. We use two measures of risk premium within each country. The first measure, TSP, is the time-series mean of the monthly return spread between two extreme IMC-beta sorted portfolios. Since IMC is a traded factor, its mean return itself is a proxy for the investment shock premium. However, theory requires it to price the whole cross section, which is captured by TSP. At the end of each June, we sort stocks into portfolios based on their IMC betas estimated from weekly returns over the past 12 months. To ensure that each portfolio is well diversified, we form decile portfolios for the three largest markets (the U.S., Japan, and UK), tercile portfolios for nine small countries (Argentina, Austria, Belgium, Brazil, China, Chile, Denmark, Indonesia, Mexico, Malaysia, Netherlands, Norway, Peru, Poland, Portugal, Spain, and Turkey), and quintile portfolios for the remaining countries. We compute the equally and value-weighted returns on the zero-investment portfolio long the highest IMC beta portfolio and short the lowest IMC beta portfolio for the following 12 months. TSP is then the mean return of this long-short portfolio.

The second measure, CSP, is the cross-sectional premium on the IMC factor, estimated by the one-step GMM procedure as described in Cochrane (2005). The moment conditions for each country simultaneously include the orthogonality conditions for the time-series regressions of each IMC beta portfolio return on a constant, IMC, and the market return, as well as the orthogonality conditions for the cross-sectional regression of the portfolio returns on the two factor loadings restricting the intercept to be zero.

Table 4.3 summarizes the two premium estimates in percentage on an equally weighted basis, in both local and U.S. currencies. We find that 23 out of the 33 countries have negative TSP in the local currency, and 22 countries do in U.S. dollar returns. The conventional level of significance (two-sided $p < 10\%$) at the relevant degrees of freedom is approximately $|t| > 1.65$. Of those negative estimates, seven are significant by that standard in the local currency (Austria, Belgium, Canada, France, Germany, Netherlands, and the U.K.), and eight are significant in U.S. dollars (Austria, Belgium, Canada, France, Germany, Hong Kong, Netherlands, and the

U.K.). None of the countries have significantly positive TSP premia in either the local or U.S. currency.

The cross-sectional premium largely echoes the message from its time-series counterpart. In local currency returns, 20 countries exhibit negative CSP, of which twelve are significant, comprising of developed and emerging countries (Austria, Belgium, Canada, China, France, Germany, Netherlands, Norway, South Korea, Sweden, and the U.K).[2] However, caution is needed as the cross-sectional estimates appear to be rather noisy; several countries have significant monthly CSP in the order of several percent, which are economically too large to justify. This may be because of the small cross section available in international data. The qualitative result on CSP barely changes upon U.S. currency conversion. There are four countries that carry a significantly positive CSP in the local currency, and also four such countries in the U.S. currency.

Table 4.4 largely confirms the above observations on a value-weighted basis. In the local (U.S.) currency, 22 (23) countries have negative TSP, of which seven (five) are significant, while none of the countries carry a significantly positive TSP. The cross-sectional analysis delivers a similar statement: In the local (U.S.) currency, 23 (23) countries have negative CSP, of which eleven (twelve) are significant, while there is no country with significantly positive CSP in either currency.

The U.S. premium is negative but insignificant throughout the two tables, regardless of weighting and the estimation method. While the time-series premium is also negative and insignificant in Papanikolaou (2011), he does find a significantly negative cross-sectional premium by an expansion of the stochastic discount factor.

[2]Following the International Finance Corporation, here we classify South Korea as well as Hong Kong and Taiwan as developed markets. The IFC developed-country dummy, $DIFC$, to be introduced below, for these countries and regions takes the value of 1.

It is possible that the difference arises from his use of the CRSP data, which is longer and more comprehensive in the coverage of U.S. stocks.

Overall, we find a spectrum of investment-shock premiums ranging from being significantly negative to positive across international markets, with more prevalence on the negative side. Importantly, significantly negative estimates tend to arise in developed countries, while positive ones in merging markets. This appears to suggest that an economy can exhibit a positive investment-shock premium in its early stage, which turns negative as it matures. This hypothesis potentially reconciles the conflicting evidence on the sign of investment-shock premium in the U.S. market; Papanikolaou (2011) and Kogan, Papanikolaou, and Stoffman (2013) estimate negative premiums using the sample from 1963, while Garlappi and Song (2016*b*) and Li (2017) find positive premiums in extended periods covering as early as the 1930's, in which the less mature U.S. economy suffered from the Great Depression. We now turn to a formal analysis of this point by seeking the determinants of investment-shock premium in the cross section of countries rather than over different sample periods within a country.

4.2. Cross-country Analysis

4.2.1. Hypothesis Development

The last section finds a large cross-country dispersion in the extent of investment shock pricing. We now explore potential determinants of such differences. We consider four types of country characteristics as potential drivers of the investment effect.

First, we explore whether the investment-shock pricing differs between developed and emerging markets. Tinn (2010) finds that high uncertainty discourages firms from adopting new technologies. Acemoglu (2002) argues that a lack of skilled labor causes delay in technological adoption. Further, Kortum and Lerner (2000) find that venture capital is the major source of funding for technology firms. Taken together, we conjecture that investment shocks are a stronger determinant of asset prices in developed countries with lower political uncertainty and more abundant skilled labor.

To test this hypothesis, we use two country-level dummy variables for economic development. $DIFC$ and $DDJI$ take the value of one if a country or region is classified as developed by the International Finance Corporation and the Dow Jones Indexes (DJI) country-classification system, respectively, and zero otherwise. The developed markets are more accessible to and supportive of foreign investors, whereas emerging markets (and frontier markets in the DJI country-classification system) are less accessible and support a smaller investment landscape. The DJI country classification is based on analysts' examination of market and regulatory structure, trading environment, and operational efficiency of each country.

The second type of country characteristics proxies for access to capital and efficiency in capital allocation. The first measure of access to capital is simply the aforementioned average real investment per capita (INV, see Table 4.1) for each country. The second measure is the investment-to-capital ratio (IK); Kogan and Papanikolaou (2013*a*) show that firms with higher IK experience greater exposures to the IMC factor. Such firms also exhibit larger output growth in response to positive IMC shocks. The average INV and IK are ex-post measures of access to capital. The third and fourth measures employ the novel dataset on capital control restrictions on inflows and outflows developed by Fernández, Klein, Rebucci, Schindler, and Uribe (2016) using the IMF's *Annual Report on Exchange Arrangements and Exchange Restrictions*. The capital control restrictions on inflows (KAI) are constructed using ten dimensions in inflow restrictions on equities, bonds, money markets, collective investments, derivatives, commercial credits, financial credits, guarantees/sureties/financial backup facilities, direct investment, and real estate. The capital control restrictions on outflows (KAO) are constructed using the outflow restrictions on the same ten dimensions as KAI. The fifth measure is the efficiency of capital allocation, measured by the elasticity of industry investment to value added (EIV) as in Wurgler (2000, Table 2, data downloaded from his website). Countries with greater allocative efficiency increase investment more in their growing industries and decrease investment more in their declining industries. Such countries should experience a greater increase in future output and consumption. Building on these results, we propose that the pricing of investment shocks should be stronger (i.e., its premium will be more negative) in countries where firms have higher INV, IK, and EIV as well as lower KAI and KAO on average.

The third type of country characteristics represents the access to financial markets and institutions. Developed financial markets provide a key role in allocating capital to productive investments, monitoring such investments, and diversifying risk (Levine (2005)). Earlier work uses simple ratios, such as private credit over GDP and stock market capitalization over GDP, to measure financial development (see, for e.g., LaPorta, Lopez-de-Silanes, Shleifer, and Vishny (1997) and Rajan and Zingales (1998)). Extending the idea to capture the increasing complexity in financial development, we employ multidimensional indexes proposed by Sahay et. al. (2015) and Svirydzenka (2016). Designed to gauge the depth of financial markets and institutions as well as access to them, the indexes are constructed from a number of data sources including the World Bank FinStats, the IMS's *Financial Access Survey*, the Dealogic corporate debt database, and the Bank for International Settlement (BIS) debt securities database. The first measure is the financial institutions depth (FID), which is a weighted index of the ratios of private-sector credit to GDP, pension fund assets to GDP, mutual fund assets to GDP, and insurance premiums to GDP. The second measure is the financial institutions access (FIA), a weighted index of the number of bank branches per 100,000 adults and ATMs per 100,000 adults. The third measure, the financial markets depth (FMD), is a weighted index of the ratios of stock market capitalization to GDP, stocks traded to GDP, international debt securities of the government to GDP, total debt securities of financial corporations to GDP, and total debt securities of non-financial corporations to GDP. The final measure is the financial markets access (FMA), a weighted index based on the percent of market capitalization excluding the ten largest companies and the total number of debt issuers. We expect that the pricing of investment shocks will be stronger in countries with higher FID, FIA, FMD, and FMA.

The fourth and last type of country characteristics captures competition in product markets and industries. Following the norm in the industrial organization literature, we use the industry net profit margin (NPM, the annual average operating income before depreciation and amortization divided by sales) as a measure of firms' market power and hence an inverse measure of competition. It is commonly used as the empirical proxy for the Lerner index, which represents firms' ability to set prices above marginal cost. Another measure of competition is import penetration ($IMPP$) downloaded from the OECD database. It gauges the extent to which domestic demand is met by imports, i.e., the degree of import competition. $IMPP$ tends to be low for big economies such as the U.S. and Japan, while geographic reasons also make it low for countries like Australia and New Zealand. Therefore, high values of $IMPP$ are shared by both small, emerging economies and developed, integrated European countries, giving it a separate role from correlated economic-development proxies such as KAI and FID.

Finally, to capture the overall effect, we construct a composite index of the above three non-dummy types of country characteristics. We choose about a half of variables, which are both strong determinants of investment premium and time varying, from each characteristic type: IK and KAI from the second type, FID and FIA from the third type, and NPM from the last type. Each year, we sort countries by IK, FID, and FIA and assign the highest rank to those with the highest characteristic values. Similarly, we sort countries by KAI and NPM every year and those with the lowest characteristic values receive the highest rank. A country's composite index for the degree of IST-shock pricing, $ISTI$, is then the time-series mean of its annual average rank over the five characteristics. We conjecture that the pricing of investment shocks will be stronger in countries with the higher values of $ISTI$.

Table 4.5 presents pairwise correlations between the country characteristics. As expected, the two development country dummy variables are strongly correlated with EIV, FID, FMD, and INV at a level of 0.6 or higher. In particular, the highest correlation in the table, 0.825, is observed between INV and $DIFC$. A closer look reveals that all pairwise correlations between these four characteristics are no less than 0.5. Therefore, firms in developed countries tend to have greater depth in financial markets and institutions, and make more investments with greater allocative efficiency. As an inverse measure of competition, NPM is strongly negatively correlated with all of these variables. Likewise we observe negative correlations between

KAI or KAO and all the other variables except for NPM, implying that more developed, accessible, and efficient countries tend to have less restrictions on capital inflows and outflows.

4.2.2. Determinants of Investment-shock Pricing

We are now ready to identify the country attributes that affect the pricing of investment shocks. We regress the value-weighted time-series or cross-sectional premium (TSP or CSP) in the local currency on a set of country characteristics proposed in the previous section. We focus on the value-weighted premium measures for brevity, as the result for equally weighted measures are similar. Since some of the characteristics are highly correlated, putting all of them together in one specification to explain a small cross section of 33 countries will cause a severe multi-collinearity problem. Therefore, we will examine several variables belonging to an economic category at a time to refine variables and reach a grand final model using our proposed composite IST-pricing index, $ISTI$.

Tables 4.6 and 4.7 report our main results for TSP and CSP, respectively. Panel A in each table examines the proxies for economic development. Consistent with our first hypothesis, Column 1 in Panel A of Table 4.6 shows that developed countries exhibit significantly lower investment-shock premiums than emerging markets: The coefficients on $DIFC$ and $DDJI$ imply that TSP is lower, or more negative, by 0.440% and 0.568%, respectively, per month in developed countries than in emerging/frontier markets. This difference is both economically and statistically significant. In contrast, TSP in emerging/frontier markets, which equals the intercept, is insignificant in both specifications.

Turning to the role of access to capital and capital allocation in Panel B, we find that all the proxies are statistically significant. The results are in accordance with the conjecture in the previous section: Countries with higher average real investment per capita (INV) and the investment-to-capital ratio (IK), both ex-post measures of access to capital, have significantly lower investment-shock premiums. Columns 3 and 4 show that greater capital control restrictions on inflows (KAI) and outflows (KAO) increase the investment shock premium, or make it less negative. The capital control restrictions on inflows explain approximately 35% (the adjusted $R^2 = 0.35$) of the variation in the investment shock premiums across countries. We also find that countries with higher efficiency of capital allocation (EIV) carry a significantly lower TSP as evidenced in Column 5.

Panel C shows that financial development plays a significant role in the pricing of investment shocks. All specifications show negative coefficients, implying that countries with greater financial development have lower investment-shock risk premiums. Of those proxies, the financial institutions access (FIA) alone garners an explanatory power of as large as 25%.

Panel D reports that both the measures of competition significantly explain the TSP and CSP, respectively. The result implies that countries with higher average industry net profit margin (NPM), an inverse measure of competition, exhibit a larger, or less negative, investment-shock premium. We also find that high values of $IMPP$ are associated with a lower investment-shock premium.

Panel E shows that $ISTI$, which captures the overall effect of access to capital, efficiency of financial markets, and competition in product markets and industries on the investment-shock effect, is associated with a significantly lower investment-shock premium. Moreover, it explains a large fraction of cross-country dispersion in the investment shock premiums: 26%. $ISTI$ remains significant when controlled for KAI, FIA, and $IMPP$.

The result using the cross-sectional premium (CSP) in Table 4.7 is similar in that all the characteristic are significant with the same expected signs. The adjusted R^2 is sometimes, but not always, smaller perhaps reflecting the noisiness of the estimates as we have seen in Table 4.4.

Figure 4.3 plots TSP against selected variables ($DDJI$, KAI, FIA, and INV) for visual inspection. Panel A confirms that TSP is generally lower, and mostly negative indeed, in developed countries than emerging markets as classified by $DDJI$. Panel B clearly depicts the positive relation between TSP and KAI, while the remaining two panels do the negative relation between TSP and FIA or INV. These three panels are annotated by the country codes of selected countries in Table 4.1. The contrast between the clusters of developed and emerging/frontier markets is striking.

Overall, our analysis suggests that access to capital, financial development and product market competition are the three key determinants of the cross-country differences in the pricing of investment-specific technology shocks proxied by the IMC factor. We further examine the importance of these characteristics in explaining the association between the sensitivity to investment shocks and the subsequent returns by examining firm level data. We construct a panel of firm level returns, in local currency, and their exposures to local investment shocks, by combining data from all 33 countries. In order to measure the overall efficiency in terms of the three characteristics of interest, we employ the newly introduced $ISTI$ measure. We conduct the following panel regression:

$$Ret_{i,t+1} = \alpha_i + \delta_t + \gamma_1\, \beta_{i,t}^{IMC} + \gamma_2\, ISTI_{C,t} + \gamma_3\, (ISTI_{C,t} * \beta_{i,t}^{IMC}) + \epsilon_{i,t+1}, \tag{4.2}$$

where $Ret_{i,t+1}$ stands for the yearly stock return of firm i at time $t+1$, α_i are firm fixed effects, δ_t are year fixed effects, $\beta_{i,t}^{IMC}$ represents the exposure to the local IMC shock at time t, $ISTI_{C,t}$ is the country level investment-shock pricing measure and ϵ_i is an error term. Our hypothesis is that firms with higher exposure to investment shocks will have relatively lower future returns in countries with higher $ISTI$. If our conjecture is correct, we must find that the coefficient estimate for the interaction between $\beta_{i,t}^{IMC}$ and $ISTI_{C,t}$ is negative.

Table 4.9 presents the results from the panel regression. Columns (I) and (II) show that both γ_1 and γ_2 are not significant. Column (III) presents the results for the full specification. Consistent with our conjecture, the results show that the interaction term between $\beta_{i,t}^{IMC}$ and $ISTI_{C,t}$, γ_3 , is negative and significant. This provides conclusive evidence that that firms with higher exposure to investment shocks tend to have relatively lower subsequent returns in countries with greater investment-shock pricing as approximated by $ISTI$.

Given the challenging nature of interpreting the interaction term, we graphically show the predictions of the model for the case in which $ISTI = 10$ (i.e., countries with lower efficiency in terms of access to capital, access to financial institutions, and competition in product markets) and $ISTI = 26$ (i.e., countries with higher efficiency in terms of access to capital, access to financial institutions, and competition in product markets). Figure 4.6 presents the response of stock returns to different sensitivities to the investment shock, at both values of $ISTI$. The left panel shows a positive association between β^{IMC} and subsequent stock returns for the low value of $ISTI$, whereas the right panel shows a negative association between the β^{IMC} and the subsequent stock return for the high value of $ISTI$. The results clearly indicate that firms with higher exposure to investment shocks will have relatively lower subsequent returns in countries with higher $ISTI$, ceteris paribus.

4.2.3. Value and Investment Effects

Existing studies using U.S. data find that a substantial part of the value premium can be explained by investment (Xing (2008)). We also know that the value effect is prevalent as well in international markets, which clearly differ in the levels of access to capital, financial development, and product market competition. Thus, international markets offer a natural laboratory to reexamine the link between investment and valueness of firms.

To address this question, we first whiten the investment-shock premium against the value premium. Since the results for TSP and CSP in the previous section were similar, we focus on the former for brevity. We regress TSP on HML with an intercept for each country. We then substitute the estimated intercept, denoted as $TSPC$ (suffix "C" for "Controlled"), for the dependent variable in the cross-country regressions in the previous section. Table 4.8 reports the result. There is indeed some sign that the value effect is linked to the investment effect in international markets; the coefficients on some variables are noticeably reduced in magnitude, and FID and FMD lose statistical significance. However, all the other variables remain significant both statistically and economically with the expected signs. For example, according to Column 2 of Panel A, the average $TSPC$ in emerging markets is only 0.079%, which will be reduced by 0.45% in developed markets. The 0.45% reduction is still significant ($t = -2.49$) and economically nontrivial. More robustly, KAI, FIA, and NPM carry significant coefficients with t-statistics of 3.03, −2.41, and 2.23, respectively, in their univariate specifications. Our composite index for IST-shock pricing, $ISTI$, remains significant with a t-statistic of −2.56 in Panel E.

Figure 4.4 plots $TSPC$ against the same four characteristics ($DDJI$, KAI, FIA, and NPM) as Figure 4.3 . While the slopes are reduced in magnitude from those in Figure 4.3 , the strong relations between $TSPC$ and the four variables clearly remain.

Figure 4.5 plots TSP and $TSPC$ against the composite index ($ISTI$) side-by-side for comparison. The left panel shows a strong negative relation between TSP and $ISTI$. Many of the emerging countries such as China, India, and Mexico exhibit lower $ISTI$ and higher, more positive investment-shock premiums and cluster in the top left region of the panel. In contrast, most of the developed nations such as Canada, Switzerland and the U.K. exhibit higher $ISTI$ and strong negative investment-shock premiums, placing themselves in the bottom right region of the panel. The right panel in Figure 4.5 continues to present a strong negative association between $TSPC$ and $ISTI$ despite some minor reduction in the slope. The important take-away is that the relative positions of the countries are generally unchanged by cleansing the value premium from the investment-shock premium.

To summarize, the investment effect appears to be associated with, but remains robust to, the value effect in international markets. This highlights the role that access to capital, financial institutions development, and product market competition play in efficient capital allocation, and the resulting pricing of investment-specific technological shocks.

4.3. Conclusions

Investment-specific technological innovations are a critical driver of long-run economic growth. Recent studies take this well-documented fact seriously and cast the mechanism in general equilibrium to deliver sharp conclusions. Despite such serious efforts, they have reached opposite conclusions both theoretically and empirically. To shed light on the potential causes of the disagreement, we take this study to a hitherto unexplored direction by employing a large panel of firms from 33 international markets.

We make three major contributions. First, we show that investment shock premiums vary in sign and magnitude across markets. The pricing tends to be negative and often significant in developed markets, while it is weakly positive in emerging markets. Second, we identify three key determinants of such cross-country dispersions. Countries with greater access to capital, better financial institutions and higher product market competition exhibit negative and larger prices of investment risk. Finally, the value effect reduces, but does not subsume, the cross-country difference in the investment effect. Our analysis adds to the growing literature on production-based asset pricing by illustrating that investment-specific technology innovations are a relevant risk factor in international markets.

Table 4.1. **Descriptive Statistics**

Country	Code	Start	End	#Firms	#Cons	#Inv	Ratio	INV	GDP
Argentina	AR	1999/07	2014/06	46.6	15.2	5.9	2.6	995.9	5457.3
Australia	AU	1988/07	2014/06	612.9	149.4	52.2	2.9	7359.8	29054.8
Austria	OE	1990/07	2014/06	50.9	13.9	6.0	2.3	7845.2	33350.8
Belgium	BG	1987/07	2014/06	74.8	31.9	10.3	3.1	6697.6	31959.5
Brazil	BR	1994/07	2014/06	261.7	90.3	24.7	3.6	868.1	4497.2
Canada	CN	1982/07	2014/06	436.6	46.8	39.0	1.2	6256.9	31210.3
Chile	CL	1994/07	2014/06	101.6	34.5	7.9	4.3	1182.3	6094.5
China	CH	1994/07	2014/06	794.7	170.2	59.2	2.9	503.3	1279.4
Denmark	DK	1988/07	2014/06	117.0	12.7	14.2	0.9	8173.4	42247.2
France	FR	1988/07	2014/06	486.8	100.0	46.3	2.2	6502.2	30846.3
Germany	BD	1990/07	2014/06	415.7	76.3	36.9	2.1	6464.3	31758.4
Greece	GR	1994/07	2014/06	209.8	117.8	27.9	4.2	3775.6	18242.8
Hong Kong	HK	1989/07	2014/06	429.4	168.5	63.5	2.7	5098.3	21970.5
India	IN	1992/07	2014/06	399.4	176.0	33.3	5.3	162.9	592.2
Indonesia	ID	1993/07	2014/06	164.0	36.1	13.6	2.7	261.6	1089.4
Italy	IT	1987/07	2014/06	185.5	50.9	20.2	2.5	5557.1	28267.7
Japan	JP	1982/07	2014/06	1435.0	295.7	167.9	1.8	7883.2	32213.6
Malaysia	MY	1986/07	2014/06	359.9	41.9	35.3	1.2	1192.2	4490.1
Mexico	MX	1992/07	2014/06	99.7	45.5	9.1	5.0	1420.8	7300.4
Netherlands	NL	1986/07	2014/06	114.0	15.6	12.9	1.2	7345.4	35896.1
Norway	NW	1989/07	2014/06	123.6	25.0	15.8	1.6	11508.2	55767.0
Peru	PE	1998/07	2014/06	94.3	39.1	5.1	7.7	534.9	2600.8
Poland	PO	1999/07	2014/06	138.3	58.9	28.9	2.0	1428.5	7316.2
Portugal	PT	1994/07	2014/06	55.4	26.8	10.6	2.5	3513.8	16000.3
Spain	ES	1989/07	2014/06	78.1	15.7	14.4	1.1	5434.8	21875.2
South Africa	SA	1986/07	2014/06	172.9	55.2	23.0	2.4	856.1	5256.5
South Korea	KO	1993/07	2014/06	743.9	123.0	39.8	3.1	4443.2	13793.4
Sweden	SD	1989/07	2014/06	239.3	20.8	35.3	0.6	8135.9	36563.2
Switzerland	SW	1987/07	2014/06	154.5	39.9	13.7	2.9	12219.8	51084.9
Taiwan	TA	1996/07	2014/06	491.1	47.3	17.3	2.7	4441.2	12689.0
Turkey	TK	1996/07	2014/06	161.8	59.5	10.9	5.5	1217.3	5959.9
U.K.	UK	1982/07	2014/06	951.8	200.4	70.2	2.9	5703.6	33043.4
U.S.	US	1982/07	2014/06	2316.9	1166.8	231.3	5.0	7604.1	37499.6

This table provides summary statistics for the 33 countries from the Datastream-Worldscope sample. Following Gomes, Kogan and Yogo (2009), we classify firms into consumption and investment good producers by classifying industries according to each country's Input-Output tables. "Code" is the Country Code from Datastream/Worldscope. "Start" and "End" show the sample period in yyyy/mm format. #Firms is the average number of firms available per year from Datastream. #Cons and #Inv are the average numbers of consumption and investment good producers, respectively, per year. "Ratio" is the ratio of #Cons to #Inv. INV and GDP are the average yearly real investment and real output per capita, respectively, in US dollars from the Worldbank database.

Table 4.2. **Correlations between IMC and Stock Return Factors**

	MKT	HML	SMB
Argentina	-0.10	0.34***	0.33***
Australia	0.25***	-0.12**	0.42***
Austria	-0.19***	0.07	0.22***
Belgium	0.08	0.05	0.14**
Brazil	-0.16**	-0.01	0.12*
Canada	0.39***	-0.10*	0.06
Chile	0.16***	0.04	-0.08
China	-0.01	-0.14**	0.23***
Denmark	-0.23***	0.22***	0.38***
France	0.30***	0.03	0.04
Germany	0.09	0.02	0.08
Greece	0.30***	0.17***	0.28***
Hong Kong	0.03	-0.19***	0.36***
India	-0.13**	0.25***	0.00
Indonesia	0.15**	0.31***	0.10
Italy	-0.05	-0.06	0.25***
Japan	0.17***	0.17***	-0.10**
South Korea	-0.04	-0.02	0.10
Malaysia	0.42***	0.35***	0.35***
Mexico	-0.07	0.06	-0.06
Netherlands	-0.32***	-0.12**	-0.01
Norway	-0.07	0.08	0.23***
Peru	0.15**	0.32***	-0.02
Poland	0.19***	0.09	0.24***
Portugal	0.09	0.17**	0.01
Spain	-0.05	0.20***	0.26***
South Africa	0.01	-0.09	0.01
Sweden	0.28***	0.17***	-0.10
Switzerland	0.02	-0.12**	0.08
Taiwan	0.19***	-0.53***	0.03
Turkey	0.21***	0.04	0.07
U.K.	0.15***	-0.11**	0.30***
U.S.	0.38***	-0.21***	0.34***
Average	0.08	0.03	0.13
Avg., Developed	0.07	-0.03	0.16
Avg., Emerging	0.10	0.12	0.10
"# > 0"	21	20	26
"# > 0", signif.	15	11	16
"# < 0"	12	13	7
"# < 0", signif.	5	9	1

This table reports the correlation between the investment-specific technological shocks, proxied by IMC, and each of the market return (MKT), the value factor (HML), and the size factor (SMB), all measured in the local currency. *, **, *** indicate significance at the 10%, 5%, and 1% levels, respectively. The "Average" is across the 33 countries in the sample, and "Avg., Developed" over the 19 developed countries and "Avg., Emerging" over the 14 emerging markets as classified by the International Finance Corporation. "# > 0" and "# < 0" are the number of positive and negative correlations, respectively, of which significant correlations are counted in "# > 0, signif." and "# < 0, signif."

Table 4.3. **Equally Weighted IST-shock Premium**

Region	Country	β_{IMC} Spread		In local currency *TSP*		In local currency *CSP*		In U.S. dollars *TSP*		In U.S. dollars *CSP*	
Africa	South Africa	1.23	(68.51)	-1.51	(-0.87)	-0.67	(-0.73)	-1.44	(-0.83)	0.31	(0.32)
Asia, Developed	Hong Kong	1.18	(64.52)	-0.38	(-1.37)	1.41	(2.56)	-0.53	(-1.89)	1.33	(2.52)
	Japan	2.21	(76.11)	-0.17	(-0.57)	-0.10	(-0.75)	-0.21	(-0.69)	-0.14	(-1.21)
	South Korea	1.96	(102.68)	-0.03	(-0.08)	-2.25	(-1.66)	-0.02	(-0.04)	-0.90	(-1.72)
	Taiwan	1.46	(54.26)	-0.10	(-0.16)	-0.24	(-0.42)	0.00	(-0.00)	-0.11	(-0.20)
Asia, Emerging	China	1.62	(40.82)	0.19	(0.74)	-0.26	(-2.10)	0.13	(0.52)	-0.22	(-2.08)
	India	1.14	(140.48)	0.12	(0.47)	1.37	(2.18)	0.12	(0.46)	1.32	(2.27)
	Indonesia	0.76	(79.76)	0.89	(1.14)	0.74	(1.23)	-0.04	(-0.10)	-0.17	(-0.07)
	Malaysia	1.25	(54.02)	0.23	(0.62)	0.37	(0.87)	0.26	(0.67)	0.39	(0.90)
Australasia, Developed	Australia	1.57	(35.78)	-0.24	(-0.79)	0.56	(1.56)	-0.24	(-0.79)	0.59	(0.59)
Europe, Developed	Austria	0.66	(71.10)	-0.96	(-3.28)	-3.75	(-4.72)	-0.98	(-3.15)	-3.38	(-4.40)
	Belgium	0.75	(81.49)	-0.70	(-2.88)	-1.40	(-2.88)	-0.54	(-2.18)	-1.07	(-2.77)
	Denmark	0.71	(84.42)	-0.03	(-0.16)	-0.13	(-0.16)	0.02	(0.09)	0.07	(0.07)
	France	1.33	(56.52)	-0.41	(-1.91)	-1.17	(-4.10)	-0.42	(-1.89)	-0.82	(-3.73)
	Germany	1.10	(51.02)	-0.66	(-2.23)	-2.09	(-2.70)	-0.64	(-2.16)	-2.53	(-2.23)
	Italy	0.83	(42.82)	0.36	(1.54)	2.84	(1.40)	0.06	(0.25)	-0.10	(-0.11)
	Netherlands	0.65	(47.19)	-0.44	(-1.91)	-0.87	(-2.52)	-0.48	(-2.04)	-1.04	(-2.89)
	Norway	0.87	(78.99)	-0.42	(-1.07)	-1.28	(-1.70)	-0.28	(-0.85)	-1.25	(-1.97)
	Spain	0.97	(67.40)	0.08	(0.29)	0.69	(3.53)	0.19	(0.65)	0.70	(3.76)
	Sweden	0.93	(62.34)	-0.29	(-0.97)	-0.78	(-2.71)	-0.26	(-0.88)	-0.75	(-2.72)
	Switzerland	1.15	(93.97)	-0.13	(-0.64)	-0.02	(-0.04)	-0.14	(-0.67)	-0.07	(-0.30)
	UK	1.76	(84.82)	-0.45	(-1.96)	-1.31	(-2.42)	-0.47	(-2.03)	-1.36	(-2.45)
Europe, Emerging	Greece	1.40	(53.75)	-0.41	(-0.77)	0.21	(0.34)	-0.37	(-0.69)	0.21	(0.46)
	Poland	1.09	(48.23)	0.39	(1.02)	0.97	(2.72)	0.36	(0.96)	0.84	(2.34)
	Portugal	0.72	(27.55)	0.15	(0.21)	-0.15	(-0.04)	0.14	(0.20)	-0.64	(-0.40)
	Turkey	0.81	(67.98)	-0.03	(-0.11)	0.31	(0.48)	0.08	(0.24)	-0.09	(-0.08)
North America, Developed	Canada	1.01	(76.11)	-0.49	(-1.93)	-1.12	(-2.71)	-0.44	(-1.78)	-1.02	(-2.49)
	US	2.79	(74.02)	-0.30	(-0.88)	-0.06	(-0.11)	-0.30	(-0.88)	-0.06	(-0.11)
South America, Emerging	Argentina	0.62	(45.54)	0.06	(0.12)	1.52	(1.30)	0.21	(0.41)	1.13	(1.44)
	Brazil	0.93	(26.21)	-0.41	(-0.68)	0.67	(0.47)	-0.42	(-0.68)	0.65	(0.41)
	Chile	0.76	(32.37)	0.77	(1.05)	-0.99	(-1.19)	0.37	(0.42)	-1.02	(-1.38)
	Mexico	0.97	(21.79)	-0.19	(-0.51)	-1.36	(-3.11)	-0.23	(-0.62)	-1.05	(-2.90)
	Peru	0.58	(41.81)	-0.83	(-1.54)	0.10	(0.03)	-0.31	(-0.64)	-0.72	(-0.30)

This table reports the premium estimates of the equally weighted *IMC* factor. In each June, we sort stocks into deciles based on *IMC* betas within each country. β_{IMC} Spread is the difference in betas between the highest and lowest deciles. *TSP* is the time-series average of the monthly return spread (in percent) between the highest and lowest *IMC* beta portfolios. *CSP* is the GMM estimate of the cross-sectional premium in percent using the decile portfolios. The sample period is from July 1982 to December 2014. The t-statistics are shown in parentheses, and are based on Newey-West (1987) standard errors with one lag for *TSP*.

Table 4.4. **Value-Weighted IST-shock Premium**

		In local currency				In U.S. dollars			
Region	Country	*TSP*		*CSP*		*TSP*		*CSP*	
Africa	South Africa	-0.07	(-0.22)	-0.07	(-0.25)	-0.13	(-0.39)	-0.11	(-0.78)
Asia, Developed	Hong Kong	0.00	(-0.01)	-0.19	(-0.42)	-0.02	(-0.05)	-0.16	(-0.31)
	Japan	-0.05	(-0.15)	0.04	(0.17)	-0.13	(-0.38)	0.04	(0.14)
	South Korea	-0.21	(-0.48)	-1.42	(-2.91)	-0.59	(-1.09)	-2.48	(-2.03)
	Taiwan	0.27	(0.43)	0.13	(0.24)	0.05	(0.11)	0.16	(0.44)
Asia, Emerging	China	0.18	(0.63)	-0.09	(-0.99)	-0.01	(-0.04)	-0.22	(-2.17)
	India	0.30	(1.07)	0.05	(0.13)	0.28	(0.97)	0.26	(1.19)
	Indonesia	1.14	(1.60)	0.63	(0.47)	0.79	(1.21)	0.76	(0.66)
	Malaysia	0.12	(0.30)	0.08	(0.12)	0.16	(0.39)	0.09	(0.17)
Australasia, Developed	Australia	-0.95	(-2.19)	-0.94	(-1.71)	-0.73	(-1.71)	-0.79	(-1.53)
Europe, Developed	Austria	-0.83	(-2.17)	-1.44	(-3.21)	-0.86	(-2.40)	-1.60	(-3.16)
	Belgium	-0.78	(-2.05)	-0.67	(-1.57)	-0.18	(-0.55)	-0.55	(-1.54)
	Denmark	-0.07	(-0.24)	-0.25	(-0.54)	-0.07	(-0.27)	-0.32	(-0.81)
	France	-0.18	(-0.51)	-0.52	(-2.48)	-0.11	(-0.34)	-0.38	(-2.27)
	Germany	-0.92	(-2.21)	-1.33	(-1.75)	-0.90	(-2.21)	-1.19	(-1.71)
	Italy	-0.11	(-0.27)	-0.65	(-0.67)	-0.02	(-0.07)	-0.33	(-0.98)
	Netherlands	-0.78	(-2.08)	-0.96	(-2.15)	-0.82	(-2.08)	-0.91	(-2.06)
	Norway	-0.07	(-0.19)	-0.45	(-1.45)	-0.12	(-0.30)	-0.63	(-1.76)
	Spain	-0.28	(-0.61)	0.03	(0.07)	-0.23	(-0.64)	-0.01	(-0.01)
	Sweden	0.19	(0.56)	-0.16	(-0.39)	0.04	(0.09)	-0.18	(-0.47)
	Switzerland	-0.31	(-1.10)	-0.36	(-2.78)	-0.33	(-1.18)	-0.56	(-2.92)
	UK	-0.62	(-1.77)	-0.78	(-2.25)	-0.55	(-1.61)	-0.85	(-2.29)
Europe, Emerging	Greece	-0.49	(-0.68)	-0.14	(-0.26)	-0.05	(-0.09)	0.17	(0.42)
	Poland	0.10	(0.21)	-0.56	(-2.43)	-0.05	(-0.10)	-0.53	(-2.32)
	Portugal	-0.43	(-0.49)	-0.77	(-0.85)	-0.82	(-1.64)	0.04	(0.04)
	Turkey	-0.17	(-0.32)	0.46	(1.06)	-0.13	(-0.23)	0.42	(0.91)
North America, Developed	Canada	-0.72	(-2.21)	-1.31	(-2.25)	-0.59	(-1.69)	-1.03	(-2.25)
	US	-0.06	(-0.15)	-0.41	(-1.12)	-0.06	(-0.15)	-0.41	(-1.12)
South America, Emerging	Argentina	0.07	(0.09)	-0.58	(-0.58)	0.24	(0.30)	-0.32	(-0.30)
	Brazil	0.23	(0.44)	0.35	(0.36)	0.32	(0.62)	0.49	(0.56)
	Chile	0.77	(1.62)	0.30	(1.32)	0.24	(0.71)	-0.10	(-0.22)
	Mexico	0.15	(0.44)	-0.36	(-2.03)	0.01	(0.04)	-0.33	(-1.81)
	Peru	-0.52	(-0.69)	0.66	(1.35)	0.66	(0.83)	1.25	(0.73)

This table reports the premium estimates of the value weighted IMC factor. In each June, we sort stocks into deciles based on IMC betas within each country. TSP is the time-series average of the monthly return spread (in percent) between the highest and lowest IMC beta portfolios. CSP is the GMM estimate of the cross-sectional premium in percent using the decile portfolios. The sample period is from July 1982 to December 2014. The t-statistics are shown in parentheses, and are based on Newey-West (1987) standard errors with one lag for TSP.

Table 4.5. **Correlations between Country Characteristics**

	$DIFC$	$DDJI$	INV	IK	KAI	KAO	EIV	NPM	$IMPP$	FID	FIA	FMD	FMA
$DIFC$	1.000												
$DDJI$	0.741	1.000											
	(0.00)												
INV	0.825	0.719	1.000										
	(0.00)	(0.00)											
IK	0.447	0.472	0.272	1.000									
	(0.01)	(0.01)	(0.16)										
KAI	-0.697	-0.798	-0.720	-0.355	1.000								
	(0.00)	(0.00)	(0.00)	(0.05)									
KAO	-0.725	-0.827	-0.732	-0.252	0.941	1.000							
	(0.00)	(0.00)	(0.00)	(0.16)	(0.00)								
EIV	0.783	0.773	0.626	0.401	-0.822	-0.780	1.000						
	(0.00)	(0.00)	(0.00)	(0.04)	(0.00)	(0.00)							
NPM	-0.575	-0.578	-0.571	-0.344	0.293	0.327	-0.389	1.000					
	(0.00)	(0.00)	(0.00)	(0.05)	(0.10)	(0.07)	(0.05)						
$IMPP$	0.224	0.203	0.135	0.243	-0.228	-0.187	0.120	0.103	1.000				
	(0.30)	(0.36)	(0.54)	(0.26)	(0.30)	(0.39)	(0.61)	(0.64)					
FID	0.728	0.663	0.573	0.329	-0.519	-0.483	0.667	-0.456	0.303	1.000			
	(0.00)	(0.00)	(0.00)	(0.07)	(0.00)	(0.01)	(0.00)	(0.01)	(0.16)				
FIA	0.490	0.676	0.514	0.134	-0.584	-0.568	0.596	-0.429	-0.048	0.503	1.000		
	(0.00)	(0.00)	(0.01)	(0.46)	(0.00)	(0.00)	(0.00)	(0.01)	(0.83)	(0.00)			
FMD	0.730	0.609	0.649	0.267	-0.465	-0.476	0.521	-0.547	0.051	0.854	0.383	1.000	
	(0.00)	(0.00)	(0.00)	(0.14)	(0.01)	(0.01)	(0.01)	(0.00)	(0.82)	(0.00)	(0.03)		
FMA	0.567	0.438	0.613	0.034	-0.426	-0.446	0.374	-0.399	-0.008	0.361	0.247	0.436	1.000
	(0.00)	(0.01)	(0.00)	(0.85)	(0.02)	(0.01)	(0.06)	(0.02)	(0.97)	(0.04)	(0.17)	(0.01)	

This table reports the correlations between country-characteristics. $DIFC$ and $DDJI$ are the developed-country dummy by the IFC and the DJI country-classification system, respectively. $MCAP$ is the proportion of stock market capitalization to the size of overall economy. EIV is the elasticity of industry investment to value added. C/A is the cash-to-assets ratio. Q is Tobin's q, proxied by the market-to-book ratio of assets. IK is the investment-to-capital ratio. INV is real investment per capita. IR is investment responsiveness. NPM is the industry net profit margin $IMPP$ is import penetration. Statistical significance at the 1%, 5%, and 10% levels is indicated by ***, **, and *, respectively.

Table 4.6. **Country-level Determinants of Time-series IST-shock Premium**

Panel A: Economic Development

	1		2	
Int	0.099	(0.78)	0.175	(1.55)
$DIFC$	-0.440***	(-2.86)		
$DDJI$			-0.568***	(-4.10)
AdjR^2	0.19		0.34	

Panel B: Access to Capital, Capital Allocation

	1		2		3		4		5	
Int	0.140	(1.08)	0.891**	(2.49)	-0.418***	(-5.30)	-0.392***	(-4.72)	0.471 *	(1.86)
INV	-0.066***	(-2.81)								
IK			-5.241***	(-2.97)						
KAI					0.979***	(4.45)				
KAO							0.736***	(4.74)		
EIV									-1.089 ***	(-3.00)
AdjR^2	0.21		0.14		0.35		0.24		0.26	

Panel C: Financial Development

	1		2		3		4	
Int	0.267	(1.31)	0.281*	(1.74)	0.173	(0.96)	0.191	(0.95)
FID	-0.848**	(-2.43)						
FIA			-0.907***	(-3.36)				
FMD					-0.821**	(-2.33)		
FMA							-0.968**	(-2.07)
AdjR^2	0.15		0.25		0.11		0.07	

Panel D: Competition

	1		2	
Int	-0.675***	(-3.33)	0.044	(0.33)
NPM	6.769**	(2.53)		
$IMPP$			-0.012***	(-3.61)
AdjR^2	0.17		0.08	

Panel E: IST Country Index

	1		2		3		4	
Int	0.517*	(1.93)	0.403	(0.83)	0.565*	(2.06)	0.680**	(2.46)
$ISTI$	-0.043***	(-3.15)	-0.038*	(-1.73)	-0.031*	(-2.04)	-0.038**	(-2.69)
KAI			0.165	(0.32)				
FIA					-0.458	(-1.37)		
$IMPP$							-0.008**	(-2.16)
AdjR^2	0.26		0.23		0.27		0.29	

This table reports the coefficient estimates from cross-country regressions of investment-shock premium on country characteristics. The dependent variables is the value-weighted time-series premium, TSP, measured in the local currency. The independent variables include the followings, along with the intercept (Int): Panel A (Economic development): the developed-country dummy ($DIFC$) by the International Finance Corporation, and the developed-country dummy computed using the Dow Jones Indexes country classification system ($DDJI$); Panel B (Access to Capital, Capital Allocation): thereal investment per capita (INV), the investment-to-capital ratio (IK), the capital control restrictions on inflows (KAI), the capital control restrictions on outflows (KAO), and the elasticity of industry investment to value added (EIV); Panel C (Financial Development): the depth in financial institutions (FID), the access to financial institutions (FIA), the depth in financial markets (FMD), and the access to financial markets (FMA); Panel D (Competition): the industry net profit margin (NPM) and the import penetration ($IMPP$). Panel E (ISTI): the country level composite index for the degree of IST-shock pricing. AdjR^2 is the adjusted R-squared. The t-statistics reported in parentheses are computed using robust standard errors. Statistical significance at the 1%, 5%, and 10% levels is indicated by ***, **, and *, respectively.

Table 4.7. **Country-level Determinants of Cross-sectional IST-shock Premium**

Panel A: Economic Development

	1		2	
Int	0.039	(0.33)	0.010	(0.07)
$DIFC$	-0.651***	(-3.99)		
$DDJI$			-0.603***	(-3.35)
AdjR^2	0.30		0.25	

Panel B: Access to Capital, Capital Allocation

	1		2		3		4		5	
Int	0.006	(0.05)	0.930**	(2.34)	-0.537***	(-4.37)	-0.515***	(-4.07)	0.265	(1.18)
INV	-0.081***	(-3.16)								
IK			-6.437***	(-3.24)						
KAI					0.657**	(2.63)				
KAO							0.481**	(2.24)		
EIV									-1.063 ***	(-3.07)
AdjR^2	0.21		0.14		0.08		0.05		0.15	

Panel C: Financial Development

	1		2		3		4	
Int	0.190	(0.98)	0.059	(0.37)	0.032	(0.16)	0.223	(0.97)
FID	-1.090***	(-3.16)						
FIA			-0.866***	(-2.76)				
FMD					-0.967**	(-2.35)		
FMA							-1.595**	(-2.73)
AdjR^2	0.17		0.14		0.11		0.15	

Panel D: Competition

	1		2	
Int	-0.641***	(-4.37)	-0.138	(-0.67)
NPM	4.979***	(2.79)		
$IMPP$			-0.014**	(-2.32)
AdjR^2	0.31		0.08	

Panel E: IST Country Index

	1		2		3		4	
Int	0.191	(0.54)	1.220**	(2.25)	0.191	(0.53)	0.411	(1.10)
$ISTI$	-0.039**	(-2.31)	-0.081***	(-3.42)	-0.039**	(-2.08)	-0.033*	(-2.01)
KAI			-1.496**	(-2.36)				
FIA					-0.003	(-0.01)		
$IMPP$							-0.011*	(-1.80)
AdjR^2	0.12		0.19		0.07		0.15	

This table reports the coefficient estimates from cross-country regressions of investment-shock premium on country characteristics. The dependent variables is the value-weighted cross-sectional premium, CSP, measured in the local currency. The independent variables include the followings, along with the intercept (Int): Panel A (Economic development): the developed-country dummy ($DIFC$) by the International Finance Corporation, and the developed-country dummy computed using the Dow Jones Indexes country classification system ($DDJI$); Panel B (Access to Capital, Capital Allocation): thereal investment per capita (INV), the investment-to-capital ratio (IK), the capital control restrictions on inflows (KAI), the capital control restrictions on outflows (KAO), and the elasticity of industry investment to value added (EIV); Panel C (Financial Development): the depth in financial institutions (FID), the access to financial institutions (FIA), the depth in financial markets (FMD), and the access to financial markets (FMA); Panel D (Competition): the industry net profit margin (NPM) and the import penetration ($IMPP$). Panel E (ISTI): the country level composite index for the degree of IST-shock pricing. AdjR^2 is the adjusted R-squared. The t-statistics reported in parentheses are computed using robust standard errors. Statistical significance at the 1%, 5%, and 10% levels is indicated by ***, **, and *, respectively.

Table 4.8. **Country-level Determinants of IST-shock Premium Controlling for Value Effect**

Panel A: Economic Development

	1		2	
Int	0.007	(0.05)	0.079	(0.49)
$DIFC$	-0.331*	(-1.78)		
$DDJI$			-0.452**	(-2.49)
AdjR^2	0.07		0.16	

Panel B: Access to Capital, Capital Allocation

	1		2		3		4		5	
Int	0.045	(0.27)	0.676	(1.64)	-0.426***	(-5.00)	-0.380***	(-4.33)	0.321	(0.89)
INV	-0.053*	(-1.91)								
IK			-4.283**	(-2.14)						
KAI					0.875***	(3.03)				
KAO							0.587***	(3.08)		
EIV									-0.893 *	(-1.78)
AdjR^2	0.10		0.06		0.22		0.11		0.14	

Panel C: Financial Development

	1		2		3		4	
Int	0.188	(0.64)	0.206	(0.98)	0.082	(0.34)	0.206	(0.85)
FID	-0.761	(-1.58)						
FIA			-0.826**	(-2.41)				
FMD					-0.683	(-1.48)		
FMA							-1.100*	(-1.96)
AdjR^2	0.09		0.17		0.05		0.08	

Panel D: Competition

	1	
Int	0.253	(0.95)
$ISTI$	-0.031**	(-2.25)
AdjR^2	0.14	

This table reports the coefficient estimates from cross-country regressions of the investment-shock premium, controlled for the value premium, on country characteristics. The dependent variable, $TSPC$, is the intercept from the regression of the value-weighted time-series TSP on the value factor, HML, measured in the local currency within each country. The independent variables include the followings, along with the intercept (Int): Panel A (Economic development): the developed-country dummy ($DIFC$) by the International Finance Corporation, and the developed-country dummy computed using the Dow Jones Indexes country classification system ($DDJI$); Panel B (Access to Capital, Capital Allocation): thereal investment per capita (INV), the investment-to-capital ratio (IK), the capital control restrictions on inflows (KAI), the capital control restrictions on outflows (KAO), and the elasticity of industry investment to value added (EIV); Panel C (Financial Development): the depth in financial institutions (FID), the access to financial institutions (FIA), the depth in financial markets (FMD), and the access to financial markets (FMA); Panel D (Competition): the industry net profit margin (NPM) and the import penetration ($IMPP$). Panel E (ISTI): the country level composite index for the degree of IST-shock pricing. AdjR^2 is the adjusted R-squared. The t-statistics reported in parentheses are computed using robust standard errors. Statistical significance at the 1%, 5%, and 10% levels is indicated by ***, **, and *, respectively.

Table 4.9. **Firm level exposure to the IST-shock and subsequent stock returns**

	(I)	(II)	(III)
IMC beta(t)	-0.015	-0.015	0.111
	(-0.71)	(-0.73)	(1.41)
ISTI(t)		-0.006	-0.004
		(-0.63)	(-0.41)
IMC beta(t) * ISTI(t)			-0.007**
			(-1.99)
Firm fixed effects	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes
AdjR^2	0.11	0.11	0.11

This table reports the average slopes and their time series t-statistics in parentheses from annual panel regressions of individual stock returns in year t+1 on exposure to Investment shocks (IMC beta) and other control variables in year t. The dependent variable is the firm-level stock return in year t+1, measured in the local currency. ISTI is the country level composite index for the degree of IST-shock pricing in year t. AdjR^2 is the adjusted R-squared. The t-statistics reported in parentheses are computed using standard errors clustered by country. Statistical significance at the 1%, 5%, and 10% levels is indicated by ***, **, and *, respectively.

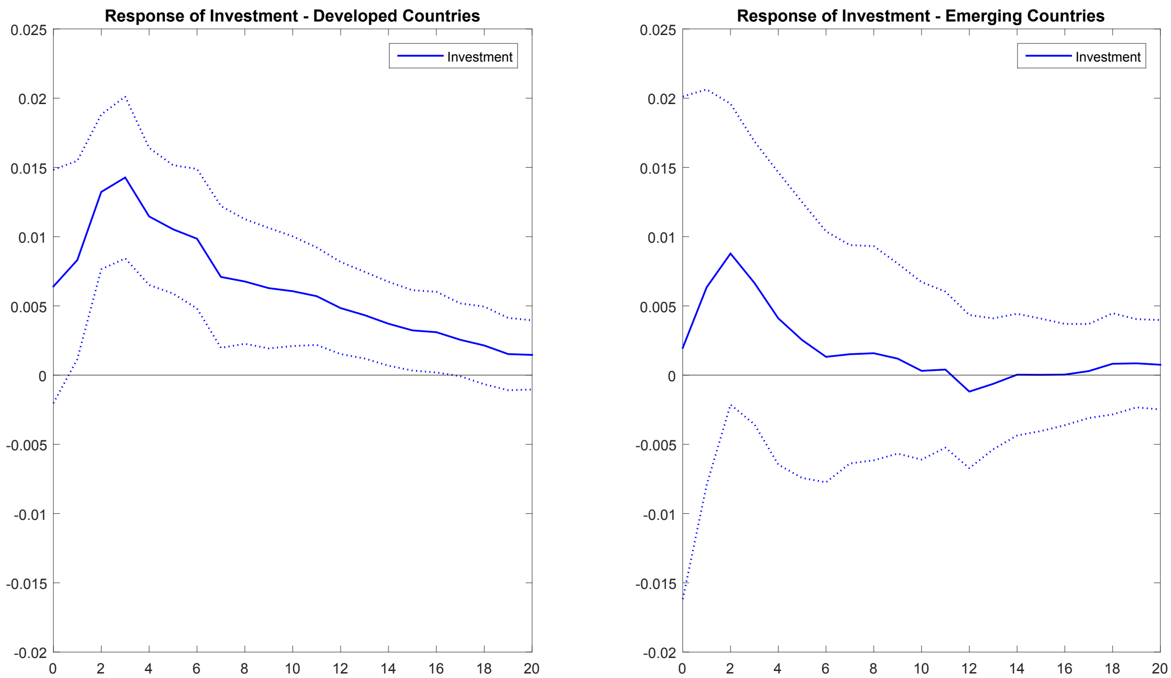


Figure 4.1. **Dynamic Response of Investment**

The figure plots the dynamic response of investment to the return spread between investment and consumption good producers. We estimate local projections in 4.1 using quarterly data. The left panel shows the response of real per capita investment for developed markets and the right panel shows the response of real per capita investment for emerging markets. The standard errors are corrected using the Newey-West (1987) procedure.

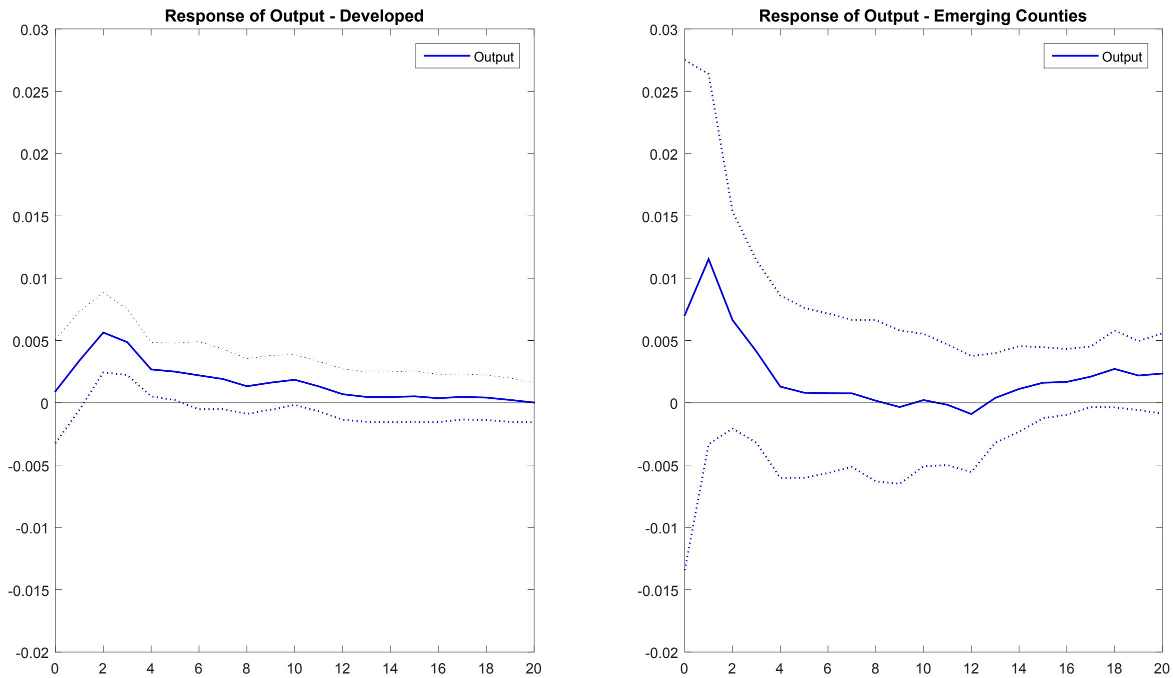


Figure 4.2. **Dynamic Response of Output**

The figure plots the dynamic response of output to the return spread between investment and consumption good producers. We estimate local projections in 4.1 using quarterly data. The left panel shows the response of real output per capita for developed markets and the right panel shows the response of real output per capita for emerging markets. The standard errors are corrected using the Newey-West (1987) procedure.

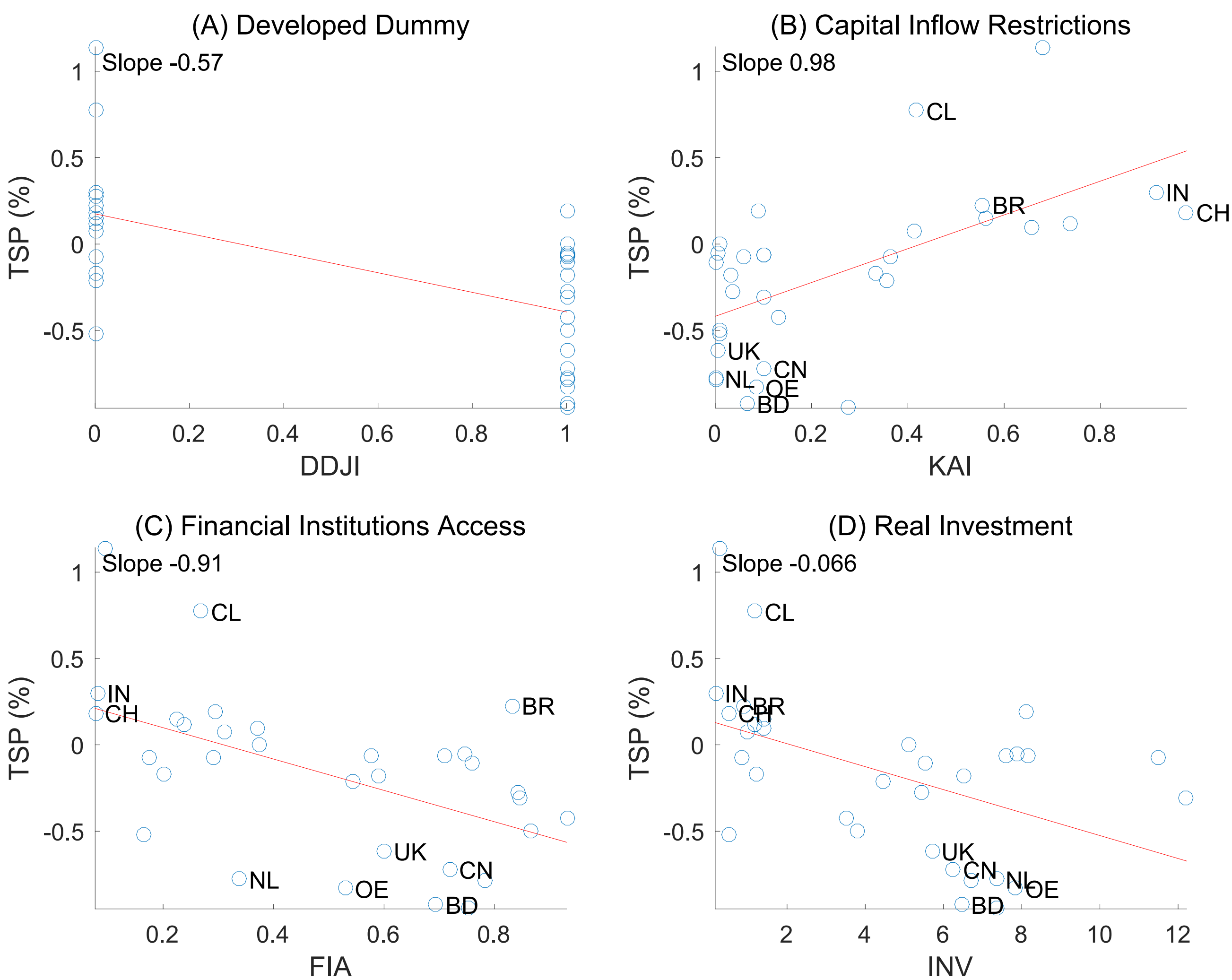


Figure 4.3. Determinants of IST-shock Premium

This figure plots the time-series IST-shock premium (TSP) against (A) the Dow-Jones Indexes developed-country dummy ($DDJI$), (B) the index for control restrictions on capital inflows (KAI), (C) the index for access to financial institutions (FIA), and (D) the real investment per capita (INV, in thousands) for the sample countries. The two-character country codes are listed in Table 4.1.

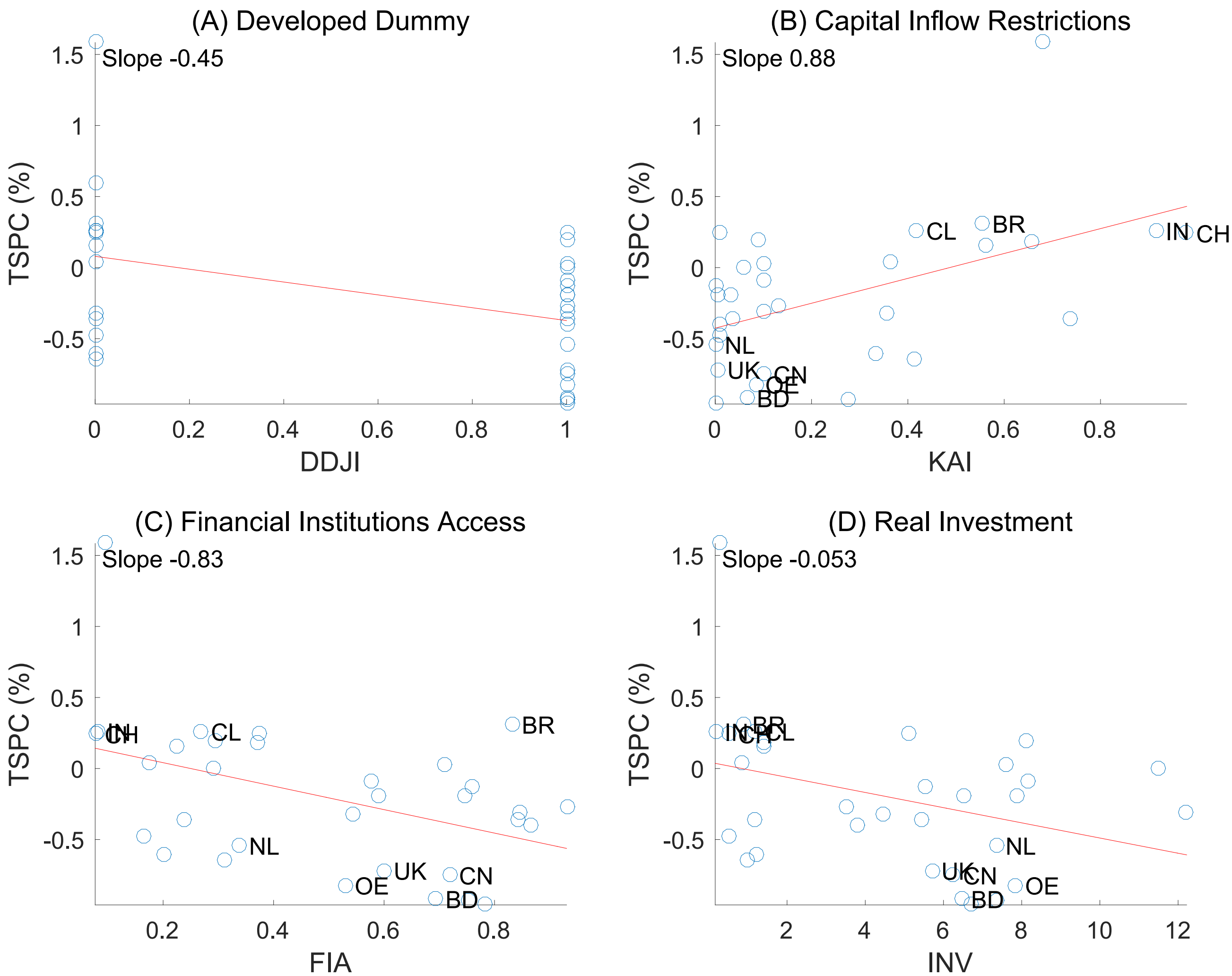


Figure 4.4. Determinants of IST-shock Premium Controlling for Value Effect

This figure plots the time-series IST-shock premium controlling for the value premium ($TSPC$) against (A) the Dow-Jones Indexes developed-country dummy ($DDJI$), (B) the index for control restrictions on capital inflows (KAI), (C) the index for access to financial institutions (FIA), and (D) the real investment per capita (INV, in thousands) for the sample countries. The two-character country codes are listed in Table 4.1.

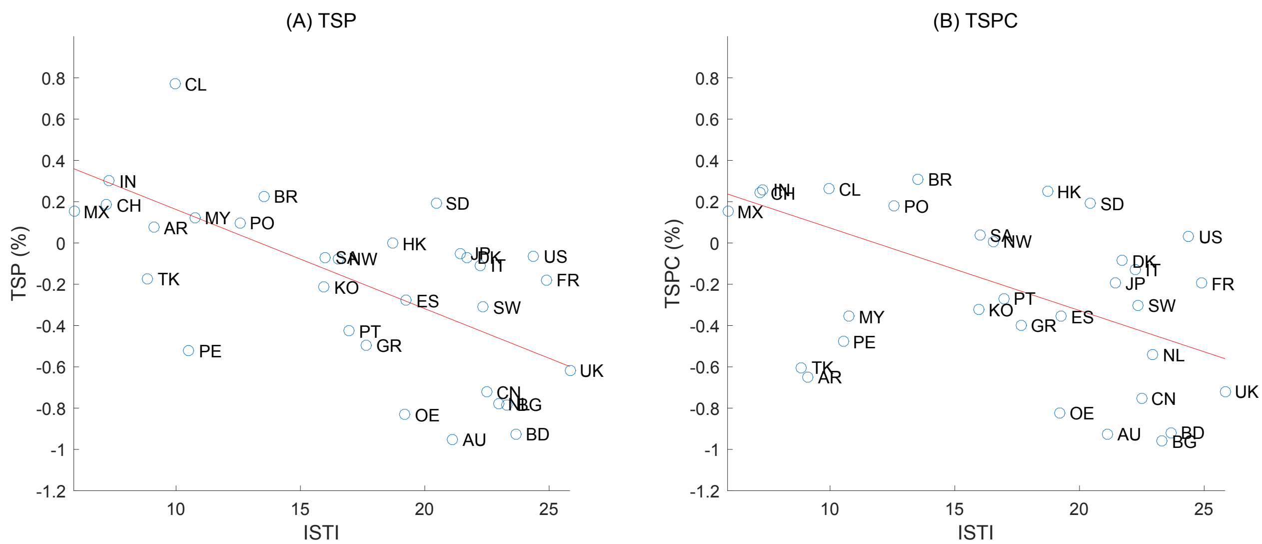


Figure 4.5. Composite Index for the Pricing of IST-Shocks

This figure plots (A) the time-series IST-shock premium (TSP), and (B) the time-series investment-shock premium controlling for the value premium ($TSPC$) against the composite index for the pricing of investment-specific technology shocks, $ISTI$. The two-character country codes are listed in Table 4.1.

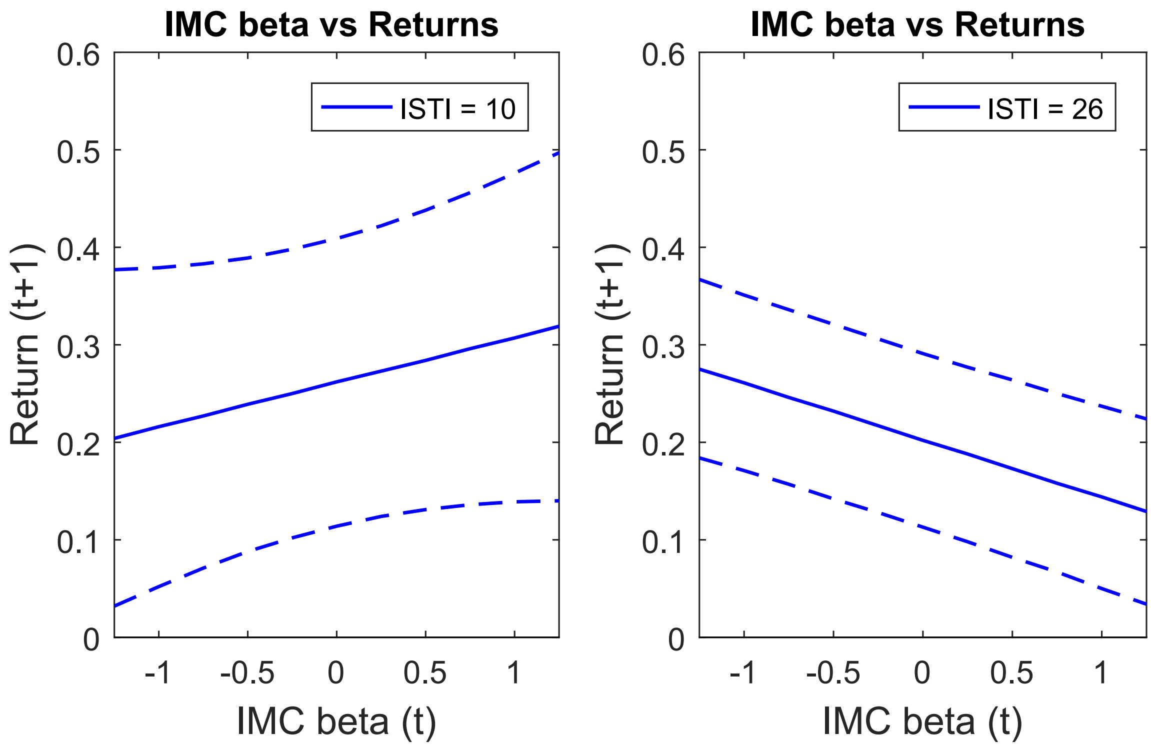


Figure 4.6. Exposure to the IST-Shock vs. Stock Returns

This figure plots the predictions of the fit model 4.2 at fixed values of $ISTI$ and averaging over the remaining covariates. $ISTI$ is the country level composite index for the degree of IST-shock pricing. The error bands are 90 percent bands based on standard errors using delta method.

References

Abel, Andrew B. 1990. "Asset prices under habit formation and catching up with the Joneses." *American Economic Review Papers and Proceedings* 80, 38–42.

Acemoglu, Daron, 2002, "Directed Technical Change," *Review of Economic Studies* 69(4), 781–809.

Acemoglu, Daron, David Autor, David Dorn, Gordon H. Hanson, and Brendan Price. 2016. "Import competition and the great US employment sag of the 2000s." *Journal of Labor Economics* 34, S141-S198.

Aiyagari, S. Rao, Lawrence J. Christiano, and Martin Eichenbaum. 1992. "The Output, Employment, and Interest Rate Effects of Government Consumption." *Journal of Monetary Economics*, 30(1): 73–86.

Aschauer, David A. 1989. "Does Public Capital Crowd Out Private Capital?." *Journal of Monetary Economics*, Vol. 24, pp. 171–188.

Autor, David, David Dorn, and Gordon Hanson. 2013a. "The China syndrome: Local labor market impacts of import competition in the United States." *American Economic Review* 103 (6), 2121-2168.

Autor, David, David Dorn, and Gordon Hanson. 2013b. "The Geography of Trade and Technology Shocks in the United States." *American Economic Review Papers and Proceedings*, 103(3), 220-225.

Autor, David, David Dorn, Gordon Hanson, and Jae Song. 2014. "Trade adjustment: Worker-level evidence." *Quarterly Journal of Economics* 129, no. 4, 1799-1860.

Baker, Scott. R., Nicholas Bloom, and Steven J. Davis. 2016. "Measuring Economic Policy Uncertainty." *Quarterly Journal of Economics*, forthcoming.

Barro, Robert J. 1990. "Government Spending in a Simple Model of Endogenous Growth." *Journal of Political Economy,* 98, October, S103-S125.

Barro, Robert J., and Charles J. Redlick. 2011. "Macroeconomic Effects from Government Purchases and Taxes." *Quarterly Journal of Economics,* 126(1): 51–102.

Baxter, Marianne, and Robert G. King. 1993. "Fiscal Policy in General Equilibrium." *American Economic Review*, 83, 315–334.

Balassa, B. 1978. "Exports and Economic Growth: Further Evidence," *Journal of Development Economics*, Vol. 5, 181-189.

Barrot, J. N., E. Loualiche, and J. Sauvagnat. 2016. "The globalization risk premium." *Working Paper*.

Bansal, R. and A. Yaron. 2004. "Risk for the Long Run: A Potential Resolution of Asset Pricing Puzzles." *Journal of Finance* 59(4), 1481–1509.

Beaudry, Paul, and Franck Portier. 2014. "News-Driven Business Cycles: Insights and Challenges." *Journal of Economic Literature*, 52(4): 993-1074.

Belo, Frederico, and Jianfeng Yu. 2013. "Government Investment and the Stock Market." *Journal of Monetary Economics*, 60(3), 325-339

Belo, Frederico, Vito D. Gala, and Jun Li. 2013. "Government Spending, Political Cycles, and the Cross-Section of Stock Returns." *Journal of Financial Economics*, 107(2), 305–324.

Benigno, Gianluca, and Christoph Thoenissen. 2003. "Equilibrium Exchange Rates and Supply-Side Performance," *Economic Journal*, 113, 103-24.

Bernard, Andrew B., and J. Bradford Jensen. 1999. "Exceptional Exporter Performance: Cause, Effect, or Both?" *Journal of International Economics*, 47(1): 1–25.

Bernard, Andrew B., J. Bradford Jensen, and Peter K. Schott. 2006a. "Trade Costs, Firms, and Productivity." *Journal of Monetary Economics*, 53(5): 917–37.

Bernard, Andrew B., J. Bradford Jensen, and Peter K. Schott. 2006b. "Survival of the Best Fit: Exposure to Low-Wage Countries and the (Uneven) Growth of U.S. Manufacturing Plants." *Journal of International Economics*, 68(1): 219–37.

Blanchard, Olivier, and Roberto Perotti. 2002. "An Empirical Characterization of the Dynamic Effects of Changes in Government Spending and Taxes on Output." *Quarterly Journal of Economics,* 117(4): 1329–1368.

Bloom, Nicholas, Mirko Draca, and John Van Reenen. 2016. "Trade induced technical change? The impact of Chinese imports on innovation, IT and productivity." *Review of Economic Studies* 83, no. 1: 87-117.

Boldrin, Michele, Lawrence J. Christiano, and Jonas D. M. Fisher. 2001. "Habit Persistence, Asset Returns, and the Business Cycle." *American Economic Review*, 91: 149–66.

Bretscher, Lorenzo., Alex C. Hsu, and Andrea Tamoni. 2016. "Level and Volatility Shocks to Government Spending: Term Structure Implications." *Working Paper*.

Broda, Christian and David E. Weinstein. 2006. "Globalization and the Gains from Variety." *Quarterly Journal of Economics*, 121, Issue 2, pp. 541-585.

Burnside, Craig, Martin S. Eichenbaum, and Jonas D. M. Fisher. 2004. "Fiscal Shocks and their Consequences." *Journal of Economic Theory*, 115, 89–117.

Bustos, Paula. 2011. "The Impact of Trade on Technology and Skill Upgrading: Evidence from Argentina," *American Economic Review*, 101 (1), 304-340.

Carhart, Mark M. 1997. "On Persistence in Mutual Fund Performance." *Journal of Finance*, 52, 57–82.

Campbell, John Y., and John H. Cochrane. 1999. "Force of Habit: A Consumption-Based Explanation of Aggregate Stock Market Behavior." *Journal of Political Economy,* 107 (April): 205–51.

Campbell, John Y., Christopher Polk, and Tuomo Vuolteenaho, 2010, Growth or glamour? Fundamentals and systematic risk in stock returns, *Review of Financial Studies* 23, 305-344.

Campbell, John Y., and Tuomo Vuolteenaho, 2004, Bad beta, good beta, *American Economic Review* 94, 1249-1275.

Christiano, Lawrence J., Martin Eichenbaum, and Charles L. Evans. 2005. "Nominal rigidities and the dynamic effects of a shock to monetary policy." *Journal of Political Economy*, 113, 1–45.

Clerides, Sofronis, Saul Lach, and James Tybout. 1998. "Is Learning by Exporting Important? Micro-dynamic Evidence from Columbia, Mexico and Morocco." *Quarterly Journal of Economics*, 113(3): 903– 47.

Cochrane, John H. 1996. "A Cross-Sectional Test of an Investment-Based Asset Pricing Model." *Journal of Political Economy* 104 (June), 572–621.

Cochrane, John H. 2005. Asset Pricing (revised ed.), Princeton University Press, Princeton, NJ.

Constantini, James A., and Marc J. Melitz. 2008. "The Dynamics of Firm-Level Adjustment to Trade," in The Organization of Firms in a Global Economy, Elhanan Helpman, Dalia Marin, and Thierry Verdier, eds. (Cambridge, MA: Harvard University Press).

Constantinides, George M. 1990. “Habit formation: A resolution of the equity premium puzzle.” *Journal of Political Economy* 98(3), 519–543.

Corsetti, Giancarlo, Luca Dedola, Silvain Leduc. 2008. “International Risk Sharing and the Transmission of Productivity Shocks.” *Review of Economic Studies* 75, 443-473.

Croce, M. Max, Howard Kung, Thien T. Nguyen, Lukas Schmid. 2012. “Fiscal policies and asset prices.” *Review of Financial Studies,* 25 (9), 2635–2672.

Cummins, J. G., and G. L. Violante. 2002. “Investment-specific Technical Change in the U.S. (1947–2000): Measurement and Macroeconomic Consequences.” *Review of Economic Dynamics* 5, 243–284.

De Loecker, Jan, Pinelopi K Goldberg, Amit K Khandelwal, and Nina Pavcnik. 2016. “Prices, markups and trade reform.” *Econometrica*, Vol.84, 2, 445-510.

Devereux Michael B., Allen C. Head and Beverly J. Lapham. 1996. “Monopolistic Competition, Increasing Returns, and the Effects of Government Spending.” *Journal of Money, Credit, and Banking*, 28, 233–254.

Dissanayake, Ruchith, 2017. “Government Spending Shocks and Asset Prices.” *Working Paper.*

Dissanayake, Ruchith. 2017. “Trade Induced Productivity Change and Asset Prices.” *Working Paper.*

Edelberg, Wendy, Martin Eichenbaum, and Jonas D. M. Fisher. 1999. “Understanding the Effects of a Shock to Government Purchases.” *Review of Economic Dynamics*, 166–206.

Epstein, L. and S. E. Zin. 1989. “Substitution, risk aversion, and the temporal behavior of consumption and asset returns: A theoretical framework.” *Econometrica* 57(4), 937–969.

Fama, Eugene F., and Kenneth R. French. 1992. “The cross-section of expected stock returns,” *Journal of Finance* XLVII, 427–465.

——. 1993. “Common Risk Factors in the Returns on Stocks and Bonds.” *Journal Financial Economics.* 33: 3–56.

——. 2015. “A five-factor asset pricing model.” *Journal of Financial Economics*, 116, 1-22.

Fama, Eugene F., and James D. MacBeth. 1973. “Risk, Return, and Equilibrium: Empirical Tests.” *Journal of Political Economy*, 81, 607–636.

Feder, G. 1983. “On Exports and Economic Growth.” *Journal of Development Economics*, Vol. 12, 59-73.

Fernandez, Andres, Klein, Michael W., Rebucci, Alessandro, Schindler, Martin, and Martin Uribe. 2016. “Capital Control Measures: A New Dataset.” *IMF Economic Review* 64, 2016, 548-574.

Fisher, Jonas D. M. 2006. “The Dynamic Effects of Neutral and Investment-Specific Technology Shocks.” *Journal of Political Economy* 114 (June), 413–51.

Fisher, Jonas D. M. and Ryan Peters, 2010. “Using Stock Returns to Identify Government Spending Shocks.” *The Economic Journal,* 120: 414–436.

Gali, Jordi, J. David Lopez-Salido, and Javier Valles. 2007. “Understanding the Effects of Government Spending on Consumption.” *Journal of the European Economic Association*, 227–270.

Garlappi, Lorenzo and Zhongzhi Song. 2016. ”Capital Utilization, Market Power, and the Pricing of Investment Shocks”, *Journal of Financial Economics*, Forthcoming.

Garlappi, Lorenzo, and Zhongzhi Song, 2016, “Can Investment Shocks Explain the Cross-Section of Equity Returns?”, *Management Science*, Forthcoming.

Goldberg, P. K., Khandelwal, A., Pavcnik N., and P. Topalova. 2010. “Imported Intermediate Inputs and Domestic Product Growth: Evidence from India.” *Quarterly Journal of Economics*, 125(4), pp. 1727-67.

Gomes, Francisco, Alexander Michaelides, and Valery Polkovnichenko. 2013. “Fiscal Policy and Asset Prices with Incomplete Markets.” *Review of Financial Studies*, 26, 2, 531-566.

Gomes, Joao F., Leonid Kogan, and Motohiro Yogo. 2009. “Durability of Output and Expected Stock Returns.” *Journal of Political Economy,* 117 (5), 941–986.

Greenwood Jeremy, Zvi Hercowitz, and Gregory W. Huffman. 1988. “Investment, capacity utilization, and the real business cycle.” *American Economic Review,* 78 (3): 402-17.

Greenwood, Jeremy, Zvi Hercowitz, and Per Krusell. 1997. “Long-Run Implications of Investment-Specific Technological Change.” *American Economic Review* 87 (June), 342–362.

Greenwood, Jeremy, Zvi Hercowitz, and Per Krusell. 2000. “The Role of Investment-Specific Technological Change in the Business Cycle.” *European Economic Review* 44, 91–115.

Grüning, Patrick. 2017. “International endogenous growth, macro anomalies, and asset prices.” *Journal of Economic Dynamics and Control*, 78, pp. 118-148.

Hall, Robert E. 1980. “Labor Supply and Aggregate Fluctuations.” *Carnegie-Rochester Conference Series on Public Policy*, 12 , 7-33.

Hlatshwayo, Sandile, and Michael Spence. 2012. “The Evolving Structure of the American Economy and the Employment Challenge.” *Comparative Economic Studies* 54 (4): 703–38.

Hlatshwayo, Sandile, and Michael Spence, 2014. “Demand and defective growth patterns: The role of the tradable and non-tradable sectors in an open economy.” *American Economic Review: Papers & Proceedings*, 104(5): 272–277.

Hulten, Charles R. 1992. “Growth Accounting when Technical Change Is Embodied in Capital.” *American Economic Review* 82, 964–980.

Ince, O., and Porter, R. 2006. “Individual equity return data from Thomson Datastream: handle with care!.” *Journal of Financial Research* 29, 463–479.

Jaimovich, Nir, and Sergio Rebelo. 2009. “Can news about the future drive the business cycle?.” *American Economic Review*, 99 (4): 1097–1118.

Jensen, J. Bradford, and Lori G. Kletzer. 2005. “Tradable Services: Understanding the Scope and Impact of Services Offshoring.” In *Brookings Trade Forum*, edited by Lael Brainard and Susan Margaret Collins, 75–133. Washington, DC: Brookings Institution.

Justiniano, Alejandro, and Bruce Preston. 2010. “Can Structural Small Open Economy Models account for the influence of foreign disturbances?,” *Journal of International Economics* 81, 61-74.

Justiniano, Alejandro, Giorgio E. Primiceri, and Andrea Tambalotti. 2010. “Investment Shocks and Business Cycles.” *Journal Monetary Economics*. 57: 132–45.

Justiniano, Alejandro, Giorgio E. Primiceri, and Andrea Tambalotti. 2011. “Investment Shocks and the Relative Price of Investment.” *Review of Economic Dynamics* 14: 101–21.

King, R. G., C. I. Plosser, and S. Rebelo. 1988. “Production, Growth and Business Cycles: I.The Basic Neoclassical Model,” *Journal of Monetary Economics*, 21, 195-232.

King, Robert G., and Sergio T. Rebelo. 1999. “Resuscitating Real Business Cycles.” In Handbook of Macroeconomics, vol. 1, edited by John B. Taylor and Michael Woodford, pp. 927–1007. Amsterdam: Elsevier.

Kogan, Leonid, and Dimitris Papanikolaou. 2013a. "Firm Characteristics and Stock Returns: The Role of Investment-Specific Shocks." *Review of Financial Studies*, forthcoming.

Kogan, Leonid, and Dimitris Papanikolaou. 2014. "Growth Opportunities, Technology Shocks, and Asset Prices." *Journal of Finance*, 69, 675-718.

Kogan, L., D. Papanikolaou, and N. Stoffman, 2013, "Technological Innovation: Winners and Losers," working paper #18671, National Bureau of Economic Research.

Kormendi, R.C., and P.G. Meguire. 1985. "Macroeconomic Determinants of Growth: Cross-Country evidence." *Journal of Monetary Economics*, 141-163.

Kortum, Samuel, and Josh Lerner. 2000. "Assessing the Contribution of Venture Capital to Innovation." *RAND Journal of Economics* 31 (4), 674–92.

Lettau, Martin, and Jessica A. Wachter, 2007, Why is long-horizon equity less risky? A duration-based explanation of the value premium, *Journal of Finance* 62, 55-92.

Leeper, Eric M., Todd B. Walker, and Shu-Chun S. Yang. 2010. "Government Investment and Fiscal Stimulus." *Journal of Monetary Economics* 57(8): 1000-1012.

Levine, R., and Renelt, D. 1992. "A sensitivity analysis of cross-country growth regressions." *American Economic Review* 82 4., 942–963.

Li, Jun, 2017. "Explaining Momentum and Value Simultaneously." *Management Science*, Forthcoming.

Li, Erica X. N., Haitao Li, and Cindy Yu. 2017. "Macroeconomic Risks and Asset Pricing: Evidence from a Dynamic Stochastic General Equilibrium Model." *Working paper.*

McLean, R. D., J. Pontiff, and A. Watanabe. 2009. "Share Issuance and Cross-sectional Returns: International Evidence." *Journal of Financial Economics* 94, 1–17.

LaPorta, R., F. Lopez-de-Silanes, A. Shleifer, and R. W. Vishny. 1997. "Legal Determinants of External Finance." *Journal of Finance* 52, 1131–1150.

Levine, Ross. 2005. "Finance and Growth: Theory and Evidence." Handbook of Economic Growth, in: Philippe Aghion and Steven Durlauf (ed.), *Handbook of Economic Growth*, edition 1, volume 1, chapter 12, pages 865-934 Elsevier.

Lileeva, Alla and Daniel Trefler. 2010. "Improved Access to Foreign Markets Raises Plantlevel Productivity For Some Plants." *Quarterly Journal of Economics*, 125(3), 1051-1099.

Mountford, Andrew, and Harald Uhlig. 2009. "What are the Effects of Fiscal Policy Shocks?." *Journal of Applied Econometrics,* 24: 960–992.

Nadiri M. Ishaq, Theofanis P. Mamuneas. 1994. "The Effects of Public Infrastructure and R&D Capital on the Cost Structure and Performance of U.S. Manufacturing Industries." *Review of Economics and Statistics*, MIT Press, vol. 76(1), pages 22-37.

Newey, W. K., and K. D. West, 1987. "A Simple, Positive Semi-definite, Heteroskedasticity and Auto Correlation Consistent Covariance Matrix." *Econometrica* 55, 703-708.

Novy-Marx, Robert, 2013. "The other side of value: The gross profitability premium," *Journal of Financial Economics* 108, 1–28.

Papanikolaou, Dimitris. 2011, "Investment Shocks and Asset Prices," *Journal of Political Economy* 119 (4), 639 685.

Pastor, Lubos, and Robert F. Stambaugh. 2003. "Liquidity Risk and Expected Stock Returns." *Journal of Political Economy,* 111, 642–685.

Pastor, Lubos, and Pietro Veronesi. 2012. "Uncertainty about government policy and stock prices." *Journal of Finance,* 67, 1219–1264.

Pavcnik, Nina. 2002. "Trade Liberalization, Exit, and Productivity Improvement: Evidence from Chilean Plants." *Review of Economic Studies*, 69(1): 245–76.

Monacelli, Tommaso, and Roberto Perotti. 2008. "Fiscal Policy, Wealth Effects, and Markups." *NBER Working Paper* No. 14584.

Rajan, Raghuram G. and Luigi Zingales. 1998. "Financial Dependence and Growth." *American Economic Review*, 88: 559-586.

Ramey, Valerie A. 2011a. "Identifying Government Spending Shocks: It's All in the Timing." *Quarterly Journal of Economic,* 126(1): 51–102.

——. 2011b. "Can Government Purchases Stimulate the Economy?." *Journal of Economic Literature,* 49(3): 673–85.

——. 2013. "Defense News Shocks, 1939–2013: Estimates Based on News Sources." http://econ.ucsd.edu/˜vramey/research/Defense_News_Narrative.pdf.

Ramey, Valerie A., and Matthew D. Shapiro. 1998. "Costly Capital Reallocation and the Effects of Government Spending." *Carnegie-Rochester Conference Series on Public Policy,* 48: 145–94.

Roberts, Mark J., and James Tybout. 1997. "The Decision to Export in Colombia: An Empirical Model of Entry with Sunk Costs." *American Economic Review*, 87(4): 545–64.

Rotemberg, Julio J., Michael Woodford. 1992. "Oligopolistic Pricing and the Effects of Aggregate Demand on Economic Activity." *Journal of Political Economy*, 100 , 1153–1297.

Sahay, Ratna, Martin Cihák, Papa N'Diaye, Adolfo Barajas, Ran Bi, Diana Ayala, Yuan Gao, Annette Kyobe, Lam Nguyen, Christian Saborowski, Katsiaryna Svirydzenka, and Seyed Reza Yousefi. 2015. "Rethinking Financial Deepening: Stability and Growth in Emerging Markets." IMF Staff Discussion Note 15/08. Washington: International Monetary Fund.

Schmitt-Grohe, Stephanie and Martin Uribe. 2012. "What's News in Business Cycles," *Econometrica*, 80 (6), 2733–2764.

Shanken, Jay, 1992. "On the Estimation of Beta-Pricing Models," *Review of Financial Studies*, 5, 1–33.

Sims, Christopher. A. 1980. "Macroeconomics and Reality." *Econometrica*, 48, 1-48.

Sims, Christopher. A., and Tao Zha. 1999. "Error Bands for Impulse Response Functions." *Econometrica*, 67, 1113–1155.

Solow, Robert M. 1960. Investment and Technological Progress in Mathematical Methods in the Social Sciences. Stanford, CA: Stanford Univ. Press.

Svirydzenka, Katsiaryna. 2016, "Introducing a New Broad-based Index of Financial Development." *IMF Working Paper*.

Tian, Mary. H. 2017. "Tradability of Output, Business Cycles, and Asset Prices," *Journal of Financial Economics,* Forthcoming.

Tinn, Katrin. 2010. "Technology Adoption with Exit in Imperfectly Informed Equity Markets." *American Economic Review* 100 (3), 925–957.

Trefler, Daniel. 2004. "The Long and Short of the Canada-US Free Trade Agreement." *American Economic Review*, 94 (4), 870-895.

Uhlig, Harald. 2010. "Understanding the Impact of Fiscal Policy: Some Fiscal Calculus." *American Economic Review Papers and Proceedings,* 100: 30-34.

Verhoogen, Eric. 2008. "Trade, Quality Upgrading, and Wage Inequality in the Mexican Manufacturing Sector." *Quarterly Journal of Economics*, 123(2): 489–530.

Watanabe, Akiko, Yan Xu, Tong Yao, and Tong Yu. 2013. "The Asset Growth Effect: Insights from International Equity Markets." *Journal of Financial Economics* 108 (2), 529-563.

Weil, P. 1989. "The equity premium puzzle and the riskfree rate puzzle." *Journal of Monetary Economics,* 24(3), 401–422.

Wurgler, Jeffrey. 2000. "Financial Markets and the Allocation of Capital." *Journal of Financial Economics* 58, 187-214.

Xing, Yuhang. 2008. "Interpreting the Value Effect Through the Q-Theory: An Empirical Investigation." *Review of Financial Studies* 21 (4), 1767-1795.

Yogo, Motohiro. 2006. "A consumption-based explanation of expected stock returns." *Journal of Finance* 61, 539-580.

APPENDIX

Appendix

1. Appendix A

In this section, I explain the first order conditions (FOCs) used to solve the model in Section 2.6 . The household problem is given by,

$$V_t = \max_{\{C_s, N_s\}} U_t \qquad \text{s.t. } C_s = w_s N_s + \Pi_{1,s} + \Pi_{2,s}, \quad s \geq t,$$

and the corresponding Lagrangian is

$$\text{(A1)} \quad \mathcal{L}_t^{HH} = U_t + \sum_{s=t}^{\infty} \lambda_s (w_s N_s + \Pi_{1,s} + \Pi_{2,s} - C_s) + \mu_t \left((C_s - hC_{s-1})^{\gamma} X_{s-1}^{1-\gamma} - X_s \right).$$

The first order conditions with respect to the control variables are given by,

$$\text{(A2)} \quad \begin{aligned} &\left(C_{t+1} - hC_t - \psi N_{t+1}^{\theta} X_{t+1}\right)^{-\sigma} + \mu_{t+1}\gamma \left(\frac{X_t^{1-\gamma}}{C_{t+1} - hC_t} \right)^{1-\gamma} \\ &-\beta h \mathbb{E}_{t+1} \left[\left(C_{t+2} - hC_{t+1} - \psi N_{t+2}^{\theta} X_{t+2}\right)^{-\sigma} - \mu_{t+2}\gamma \left(\frac{X_{t+1}^{1-\gamma}}{C_{t+2} - hC_{t+1}} \right)^{1-\gamma} \right] = \lambda_t. \end{aligned}$$

$$\text{(A3)} \quad \psi N_t^{\theta} \left(C_t - hC_{t-1} - \psi N_t^{\theta} X_t\right)^{-\sigma} + \mu_t = \beta \mathbb{E}_t \left[\mu_{t+1} (1-\gamma) (C_{t+1} - hC_t)^{\gamma} X_t^{-\gamma} \right].$$

$$\text{(A4)} \quad \theta \psi N_t^{\theta-1} X_t \left(C_t - hC_{t-1} - \psi N_t^{\theta} X_t\right)^{-\sigma} = \lambda_t \alpha_1 \frac{(1-\tau_t) Y_{1,t}}{N_{1,t}}.$$

$$\theta\psi N_t^{\theta-1}X_t\left(C_t - hC_{t-1} - \psi N_t^{\theta}X_t\right)^{-\sigma} = \lambda_t\alpha_2\frac{(1-\tau_t)\,Y_{2,t}}{N_{2,t}}. \tag{A5}$$

$$C_t = (1-\tau_t)\,Y_t - \frac{I_t}{Z_t}. \tag{A6}$$

The *PRIV* firm's problem is

$$V_{P,t} = \max_{\{I_{1,s},K_{1,s+1},N_{1,s}\}} \mathbb{E}_t\sum_{s=t}^{\infty}M_{t,s}\ \Pi_{1,s} \quad \text{s.t. } \Pi_{1,s} = (1-\tau_s)\,A_{1,s}N_{1,s}^{\alpha_1}K_{1,s}^{1-\alpha_1} - w_sN_{1,s} - \frac{I_{1,s}}{Z_s},$$

and the corresponding Lagrangian is:

(A7)

$$\mathcal{L}_t^P = \mathbb{E}_t\sum_{s=t}^{\infty}M_{t,s}\left(\begin{array}{c}(1-\tau_s)\,A_{1,s}N_{1,s}^{\alpha_1}K_{1,s}^{1-\alpha_1} - w_sN_{1,s} - \frac{I_{1,s}}{Z_s}\\ +\eta_s^1\left(I_{1,s}\left[1-\frac{\phi}{2}\left(\frac{I_{1,s}}{I_{1,s-1}}-1\right)^2\right] + (1-\delta)\,K_{1,s} - K_{1,s+1}\right)\end{array}\right).$$

The *PRIV* firm's first order conditions with respect to the control variables are given by,

$$\eta_t^1 = \beta\mathbb{E}_tM_{t+1}\left[(1-\alpha_1)(1-\tau_s)\,A_{1,t+1}N_{1,t+1}^{\alpha_1}K_{1,t+1}^{-\alpha_1} + \eta_{t+1}^1(1-\delta)\right]. \tag{A8}$$

$$\begin{aligned}1/Z_t = {} & \eta_t^1\left[1-\frac{\phi}{2}\left(\frac{I_{1,t}}{I_{1,t-1}}-1\right)^2 - \phi\left(\frac{I_{1,t}}{I_{1,t-1}}-1\right)\left(\frac{I_{1,t}}{I_{1,t-1}}\right)\right]\\ & +\beta\mathbb{E}_t\left[M_{t+1}\eta_{t+1}^1\phi\left(\frac{I_{1,t+1}}{I_{1,t}}-1\right)\left(\frac{I_{1,t+1}}{I_{1,t}}\right)^2\right].\end{aligned} \tag{A9}$$

$$\alpha_1(1-\tau_t)\,A_{1,t}N_{1,t}^{\alpha_1-1}K_{1,t}^{1-\alpha_1} = w_t. \tag{A10}$$

$$K_{1,t+1} = I_{1,t}\left[1-\frac{\phi}{2}\left(\frac{I_{1,t}}{I_{1,t-1}}-1\right)^2\right] + (1-\delta)\,K_{1,t}. \tag{A11}$$

The *GOVT* firm's problem is

$$V_{G,t} = \max_{\{I_{2,s},K_{2,s+1},N_{2,s}\}} \mathbb{E}_t \sum_{s=t}^{\infty} M_{t,s}\ \Pi_{2,s} \quad \text{s.t. } \Pi_{2,s} = (1-\tau_s)\, A_{2,s} N_{2,s}^{\alpha_2} K_{2,s}^{\alpha_{k2}} K_{G,s}^{\alpha_{g2}} - w_s N_{2,s} - \frac{I_{2,s}}{Z_s},$$

and the corresponding Lagrangian is given by,

(A12)

$$\mathcal{L}_t^G = \mathbb{E}_t \sum_{s=t}^{\infty} M_{t,s} \left(\begin{array}{c} (1-\tau_s)\, A_{2,s} N_{2,s}^{\alpha_2} K_{2,s}^{\alpha_{k2}} K_{G,s}^{\alpha_{g2}} - w_s N_{2,s} - \frac{I_{2,s}}{Z_s} \\ +\eta_s^1 \left(I_{2,s} \left[1 - \frac{\phi}{2} \left(\frac{I_{2,s}}{I_{2,s-1}} - 1 \right)^2 \right] + (1-\delta)\, K_{2,s} - K_{2,s+1} \right) \end{array} \right).$$

The *GOVT* firm's first order conditions with respect to the control variables are given by:

$$\text{(A13)} \qquad \eta_t^2 = \beta \mathbb{E}_t M_{t+1} \left[(1-\alpha_k)(1-\tau_s)\, A_{2,t+1} N_{2,t+1}^{\alpha_2} K_{2,t+1}^{\alpha_k - 1} K_{G,t+1}^{\alpha_G} + \eta_{t+1}^2 (1-\delta) \right].$$

$$1/Z_t = \eta_t^2 \left[1 - \frac{\phi}{2} \left(\frac{I_{2,t}}{I_{2,t-1}} - 1 \right)^2 - \phi \left(\frac{I_{2,t}}{I_{2,t-1}} - 1 \right) \left(\frac{I_{2,t}}{I_{2,t-1}} \right) \right]$$

$$\text{(A14)} \qquad + \beta \mathbb{E}_t \left[M_{t+1} \eta_{t+1}^2 \phi \left(\frac{I_{2,t+1}}{I_{2,t}} - 1 \right) \left(\frac{I_{2,t+1}}{I_{2,t}} \right)^2 \right].$$

$$\text{(A15)} \qquad \alpha_2 (1-\tau_t)\, A_{2,t} N_{2,s}^{\alpha_2 - 1} K_{2,s}^{\alpha_{k2}} K_{G,s}^{\alpha_g} = w_t.$$

$$\text{(A16)} \qquad K_{2,t+1} = I_{2,t} \left[1 - \frac{\phi}{2} \left(\frac{I_{2,t}}{I_{2,t-1}} - 1 \right)^2 \right] + (1-\delta)\, K_{2,t}.$$

All markets clear in equilibrium. Substituting the government budget constraint, $C_{G,t} + I_{G,t} = \tau_t (Y_{1,t} + Y_{2,t})$, and the firm profit functions into the household constraint,

$C_t = w_t N_t + \Pi_{1,t} + \Pi_{2,t}$, gives the economy wide constraint:

$$Y_t = C_t + \frac{I_t}{Z_t} + C_{G,t} + I_{G,t}. \tag{A17}$$

The Tobin's marginal q is $q_t^i = \frac{\eta_t^i}{\lambda_t}$. In this form, q_t is the marginal value of investment in terms of consumption for sector i.

Table A1. Response of Policy Uncertainty to a Government Spending shock

The top panel shows the response of Baker, Bloom, and Davis (2016) *EPU* measure based on newspaper coverage frequency. This sample includes quarterly data from 1985 to 2008. The bottom panel shows the response of the *EPU* measure based on historical archives for six major newspapers. This sample includes quarterly data from 1965 to 2008. The dashed lines represent 90% bootstrapped standard error bands. The responses are normalized such that the maximum response of real government spending is equal to one.

2. Appendix B

Appendix B presents the first order conditions of the real business cycle model and the moments from the model simulation and two-way independently sorted portfolios on the exposure to the trade induced productivity shock and Investment-to-Capital (I/K) ratio. I define IK_t as I_t/K_{t-1}, where I_t is the capital expenditure at time t and K_{t-1} is the net fixed assets at time $t-1$.

Appendix B also reports portfolios sorted on exposure to the trade induced productivity shock, for both low and high shipping cost (SC) industries. I use the average SC reported in Barrot, Loualiche, and Sauvagnat (2016) to split manufacturing industries into low versus high SC industries. Shipping costs are measured as the percentage difference of the Cost-Insurance-Freight value with the Free-on-Board value of imports. I use the time series averages given the substantial persistence in SCs over time. For simplicity, I employ 2-digit SIC codes. Panel A shows the results for manufacturing firms with traditionally low SCs (Average SC less than 0.04). Low shipping cost industries include Transportation Equipment, Instruments & Related Products, Electronic & Other Electric Equipment, Industrial Machinery & Equipment, and Miscellaneous Manufacturing Industries. Panel B shows the results for manufacturing firms with traditionally high SCs (Average SC greater than 0.05). High shipping cost industries include Leather & Leather Products, Textile Mill Products, Paper & Allied Products, Rubber & Miscellaneous Plastics Products, Food & Kindred Products, Lumber & Wood Products, Furniture & Fixtures, and Stone, Clay, & Glass Products.

2.0.1. First Order Conditions. The household maximize the recursive utility in 3.1 subject to the budget constraint 3.2 . They solve the following problem:

$$\max_{\{C_S,L_S\}_{S=t}^{\infty}} U_t, \text{ s.t. } C_S = w_S L_S + D_{C,S} + D_{I,S}, \;\; s \geqslant t. \tag{B1}$$

The corresponding Lagrangian is:

$$\mathcal{L}_t^{HH} = U_t + \lambda_t \left(w_t L_t + D_{C,t} + D_{I,t} - C_t \right). \tag{B2}$$

The household's first order conditions w.r.t. C_t, L_t, and λ_t are given by

$$\lambda_t = (1-\beta) C_t^{-\frac{1}{\Psi}} \left(1 - \psi L_t^{\theta}\right)^{1-\frac{1}{\Psi}} U_t^{\frac{1}{\Psi}}, \tag{B3}$$

$$\lambda_t w_t = (1-\beta) C_t^{1-\frac{1}{\Psi}} \left(1 - \psi L_t^{\theta}\right)^{-\frac{1}{\Psi}} U_t^{\frac{1}{\Psi}} \theta \psi L_t^{\theta-1}, \tag{B4}$$

$$Y_t = C_t + I_t, \tag{B5}$$

respectively. The non-tradable firm maximizes its dividend stream 3.6 s.t. the capital constraint 3.12 . The corresponding Lagrangian is:

(B6)

$$\mathcal{L}_t^{N} = \mathbb{E}_t \sum_{s=t}^{\infty} \mathbb{M}_{t,s} \begin{pmatrix} Y_{N,s} - w_s L_{N,s} - I_{N,s} \\ +\eta_{N,s} \left((1-\delta) K_{N,s} + \mu_s I_{N,s} \left[1 - \frac{\phi_N}{2} \left(\frac{I_{N,s}}{I_{N,s-1}} - 1 \right)^2 \right] \right) - K_{N,s+1} \end{pmatrix}.$$

The consumption firm's first order conditions w.r.t. $L_{N,t}$, $I_{N,t}$, $\eta_{N,t}$, $K_{N,t+1}$ are

$$(1-\beta_N) A_t K_{N,t}^{\beta_N} L_{N,t}^{-\beta_N} = w_t, \tag{B7}$$

$$\eta_{N,t}\ \mu_t \left[1-\frac{\phi_N}{2}\left(\frac{I_{N,t}}{I_{N,t-1}}-1\right)^2-\phi_N\left(\frac{I_{N,t}}{I_{N,t-1}}-1\right)\left(\frac{I_{N,t}}{I_{N,t-1}}\right)\right]$$

(B8)
$$+\mathbb{E}_t\left[\mathbb{M}_{t,t+1}\eta_{N,t+1}\mu_{t+1}\phi_N\left(\frac{I_{N,t+1}}{I_{N,t}}-1\right)\left(\frac{I_{N,t+1}}{I_{N,t}}\right)^2\right]=1,$$

(B9)
$$(1-\delta)\,K_{N,t}+\mu_t I_{N,t}\left[1-\frac{\phi_N}{2}\left(\frac{I_{N,t}}{I_{N,t-1}}-1\right)^2\right]=K_{N,t+1},$$

(B10)
$$\mathbb{E}_t\left[\mathbb{M}_{t,t+1}\left\{\beta_N A_{t+1}K_{N,t+1}^{\beta_N-1}L_{N,t+1}^{1-\beta_N}+(1-\delta)\,\eta_{N,t+1}\right\}\right]=\eta_{N,t},$$

respectively.

The T-good firm maximizes its dividend stream 3.9 s.t. the capital constraint 3.12 . The corresponding Lagrangian is:

(B11)
$$\mathcal{L}_t^T = E_t\sum_{s=t}^{\infty}\mathbb{M}_{t,s}\left(\begin{array}{c} p_{T,s}Y_{T,s}-w_sL_{T,s}-I_{T,s} \\ +\eta_{T,s}\left((1-\delta)\,K_{T,s}+\mu_T I_{T,s}\left[1-\frac{\phi_T}{2}\left(\frac{I_{T,s}}{I_{T,s-1}}-1\right)^2\right]\right)-K_{T,s+1}\end{array}\right).$$

The T-good firm's first order conditions w.r.t. $L_{T,t}$, $I_{T,t}$, $\eta_{T,t}$, $K_{T,t+1}$ are given by

(B12)
$$p_{T,t}\,(1-\beta_T)\,A_tZ_tK_{T,t}^{\beta_T}L_{T,t}^{1-\beta_T}=w_t,$$

$$\eta_{T,t}\ \mu_t\left[1-\frac{\phi_T}{2}\left(\frac{I_{T,t}}{I_{T,t-1}}-1\right)^2-\phi_I\left(\frac{I_{T,t}}{I_{T,t-1}}-1\right)\left(\frac{I_{T,t}}{I_{T,t-1}}\right)\right]$$

(B13)
$$+\mathbb{E}_t\left[\mathbb{M}_{t,t+1}\eta_{T,t+1}\mu_{t+1}\phi_T\left(\frac{I_{T,t+1}}{I_{T,t}}-1\right)\left(\frac{I_{T,t+1}}{I_{T,t}}\right)^2\right]=1,$$

$$\text{(B14)} \qquad (1-\delta)\,K_{T,t} + \mu_t I_{T,t}\left[1 - \frac{\phi_T}{2}\left(\frac{I_{T,t}}{I_{T,t-1}} - 1\right)^2\right] = K_{T,t+1},$$

$$\text{(B15)} \qquad \mathbb{E}_t\left[\mathbb{M}_{t,t+1}\left\{\beta_T A_{t+1} Z_{t+1} K_{T,t+1}^{\beta_T - 1} L_{T,t+1}^{1-\beta_T} p_{T,t+1} + (1-\delta)\,\eta_{T,t+1}\right\}\right] = \eta_{T,t}.$$

The market clearing conditions are in 3.15 . The wage rate in the economy is given by

$$\text{(B16)} \qquad w_t = (1-\beta_N)\,A_t K_{N,t}^{\beta_N} L_{N,t}^{1-\beta_N} = p_{T,t}\,(1-\beta_T)\,A_t Z_t^{TIP} K_{T,t}^{\beta_T} L_{T,t}^{1-\beta_T}.$$

The feasibility constraint for the N-sector is given by

$$\text{(B17)} \qquad Y_{N,t} = C_{N,t} + I_{1t}.$$

The feasibility constraint for the T-sector is given by

$$\text{(B18)} \qquad p_{T,t} \cdot Y_{T,t} = p_{m,t} C_{M,t} + I_{2t}.$$

Table B1. Model versus Data: Volatility

	Data	Model
Consumption	1.59	1.65
Investment	4.94	3.95
Labor	2.52	0.45
Output	1.56	2.04
Risk premium	17.72	3.95
Risk-free rate	3.14	0.84

This table compares the volatilities of data to simulated moments from the model. The moments in data are computed over the post war (1947 to 2016) time period.

Table B2. Portfolios sorted on TMN beta and Investment-to-Capital ratio

a) Excess returns

		β^{TMN}						
		L	2	3	4	H	H-L	
	S	0.854	0.803	0.774	0.719	0.621	-0.232	(-1.04)
I/K	2	0.749	0.560	0.637	0.663	0.462	-0.287	(-1.34)
	B	0.939	0.674	0.497	0.484	0.422	-0.517	(-2.70)
		0.086	-0.129	-0.277	-0.235	-0.199		
		(0.56)	(-0.88)	(-2.09)	(-1.53)	(-1.01)		

b) β^{TMN}

		β^{TMN}				
		L	2	3	4	H
	S	-1.823	-0.770	-0.336	0.070	0.992
I/K	2	-1.646	-0.760	-0.336	0.064	0.893
	B	-1.750	-0.773	-0.338	0.071	1.004

c) Market Equity

		β^{TMN}				
		L	2	3	4	H
	S	747.1	1110.4	1593.4	2290.6	2234.7
I/K	2	1392.3	1496.7	2539.2	4578.4	5106.9
	B	695.5	1216.8	2155.4	2878.6	2206.4

d) BE/ME

		β^{TMN}				
		L	2	3	4	H
	S	0.998	1.026	0.996	1.031	0.907
I/K	2	0.867	0.875	0.692	0.815	0.737
	B	0.732	0.735	0.731	0.688	0.596

The table reports summary statistics for portfolios sorted on β^{TMN} and Investment-to-Capital ratio. Each year in July, the firms are independently sorted into quintiles by their β^{TMN} and terciles by their previous fiscal year Investment-to-Capital ratios, with a 36 month holding period. The exposure to the tradability shock, β^{TMN} is calculated using the prior 120 months of data. I/K is the ratio of capital expenditures to the net book value of fixed assets at the beginning of each fiscal year. Standard errors are corrected using Newey and West (1987) procedure with 12 lags. The sample includes data from July 1965 to June 2016.

Table B3. Portfolios Sorted on TMN beta - Low vs. High Shipping Cost Industries

Panel A: Industries with Low Shipping Costs				
	L	2	H	H-L
Excess value-weighted returns	1.078	0.509	0.563	-0.516
(t-stat)	(3.60)	(2.32)	(2.47)	(-2.67)
β^{TMN}	-1.387	-0.284	0.722	
β^{MKT}	0.998	0.992	1.148	

Panel B: Industries with High Shipping Costs				
	L	2	H	H-L
Excess value-weighted returns	0.887	0.675	0.599	-0.288
(t-stat)	(3.52)	(3.17)	(2.95)	(-1.65)
β^{TMN}	-1.307	-0.369	0.395	
β^{MKT}	0.906	0.855	0.915	

The table reports the value-weighted and equal-weighted excess returns for portfolios sorted on the exposure to the trade induced productivity shock. Standard errors are in brackets and are corrected using Newey and West (1987) procedure with 12 lags. The exposure to the trade induced productivity shock , β^{TMN}, the exposure to the investment-specific technological shock, β^{IMC}, and the exposure to the market portfolio, β^{MKT}, are computed using regressions with the prior 60 months of data. The sample includes data from July 1965 to June 2016.

3. Appendix C

Table C1. **Sources of National Input-output Tables**

	Country	Source	Website
Africa	South Africa	The Organisation for Economic Co-operation and Development	http://stats.oecd.org/
Asia, Developed	Hong Kong	Asian Development Bank	http://www.adb.org/data/icp/input-output-tables/outputs
	Japan	Statistics Bureau, Director-General for Policy Planning and Statistical Research and Training Institute	http://www.stat.go.jp/english/data/io/
	South Korea	The Organisation for Economic Co-operation and Development	http://stats.oecd.org/
	Taiwan	National Statistics Republic of China	http://eng.stat.gov.tw/ct.asp?xItem=29540&ctNode=1650&mp=5
Asia, Emerging	China	National Bureau of Statistics of China	http://www.stats.gov.cn/english/statisticaldata/yearlydata/YB2000e/C18E.htm
	India	The Organisation for Economic Co-operation and Development	http://stats.oecd.org/
	Indonesia	The Organisation for Economic Co-operation and Development	http://stats.oecd.org/
	Malaysia	Asian Development Bank	http://www.adb.org/data/icp/input-output-tables/outputs
Australasia, Developed	Australia	Australian Bureau of Statistics	http://www.abs.gov.au/AusStats/ABS@.nsf/MF/5209.0.55.001
Europe, Developed	Austria	The Statistical Office of the European Union	http://epp.eurostat.ec.europa.eu/portal/page/portal/esa95_supply_use_input_tables/data/database
	Belgium	The Statistical Office of the European Union	http://epp.eurostat.ec.europa.eu/portal/page/portal/esa95_supply_use_input_tables/data/database
	Denmark	The Statistical Office of the European Union	http://epp.eurostat.ec.europa.eu/portal/page/portal/esa95_supply_use_input_tables/data/database
	France	The Statistical Office of the European Union	http://epp.eurostat.ec.europa.eu/portal/page/portal/esa95_supply_use_input_tables/data/database
	Germany	The Statistical Office of the European Union	http://epp.eurostat.ec.europa.eu/portal/page/portal/esa95_supply_use_input_tables/data/database
	Italy	The Statistical Office of the European Union	http://epp.eurostat.ec.europa.eu/portal/page/portal/esa95_supply_use_input_tables/data/database
	Netherlands	The Statistical Office of the European Union	http://epp.eurostat.ec.europa.eu/portal/page/portal/esa95_supply_use_input_tables/data/database
	Norway	The Statistical Office of the European Union	http://epp.eurostat.ec.europa.eu/portal/page/portal/esa95_supply_use_input_tables/data/database
	Sweden	The Statistical Office of the European Union	http://epp.eurostat.ec.europa.eu/portal/page/portal/esa95_supply_use_input_tables/data/database
	Switzerland	The Organisation for Economic Co-operation and Development	http://stats.oecd.org/
	UK	The Office for National Statistics	http://www.ons.gov.uk/ons/guide-method/method-quality/specific/economy/input-output–uk-national-accounts/
Europe, Emerging	Greece	The Statistical Office of the European Union	http://epp.eurostat.ec.europa.eu/portal/page/portal/esa95_supply_use_input_tables/data/database
	Turkey	The Statistical Office of the European Union	http://epp.eurostat.ec.europa.eu/portal/page/portal/esa95_supply_use_input_tables/data/database
North America, Developed	Canada	Statistics Canada	http://www5.statcan.gc.ca/subject-sujet/result-resultat?pid=3764&id=2745&lang=eng&type=ARRAY&sortType=1&pageNum=0
	US	The Bureau of Economic Analysis	http://www.bea.gov/industry/io_annual.htm
South America, Emerging	Brazil	The Organisation for Economic Co-operation and Development	http://stats.oecd.org/
	Chile	The Organisation for Economic Co-operation and Development	http://stats.oecd.org/
	Mexico	The Organisation for Economic Co-operation and Development	http://stats.oecd.org/
	Peru	PER Instituto Nacional de Estadstica e Informtica	http://www.inei.gob.pe/bases-de-datos/

This table shows the sources of national input-output tables used to identify investment- and consumption-good industries.