BROOKINGS

The Potential Impact of the Global Financial Crisis on World Trade

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Abstract

This paper models the global financial crisis as a combination of shocks to global housing markets and sharp increases in risk premia of firms, households and international investors in an intertemporal (or DSGE) global model. The model has six sectors of production and trade in 15 major economies and regions. The paper shows that the shocks observed in financial markets can be used to generate the severe economic contraction in global trade and production experienced in 2009. In particular the distinction between the production and trade of durable and non durable goods plays a key role in explaining the much larger contraction in trade than GDP experienced by most economies. The paper explores the implications of the large increase in fiscal deficits and the implications of a global trade war in response to the financial crisis.

1. *What this study is about*

The September 2008 collapse of Lehman Brothers, a mid-size 'Wall Street' investment banker, sent a wave of fear around world financial markets. Banks virtually stopped lending to each other. The risk premium on interbank borrowing shot up to 5 percent, whereas typically it was close to zero. Although authorities scrambled to inject liquidity into financial markets, the damage was done. The risk premium on corporate bonds shot up even more to over 6 percent. Large CAPEX projects were shelved, the corporate sector virtually stopped borrowing, trade credit was hard to get and, with falling demand, particularly for investment goods and manufacturing durables like cars, trade volumes collapsed.

The result is that the global financial crisis has seen the largest and sharpest drop in global economic activity of the modern era. In 2009, most major developed economies find themselves in a deep recession. The fallout for global trade, both for volumes and the pattern of trade has been dramatic. The OECD predicts world trade volumes could shrink by 13 percent in 2009 from 2008 levels.[1]

The contraction in trade has several interrelated causes comprising both price and income effects as global financial flows readjust, real exchange rates realign, terms of trade change and domestic savings rise with a concomitant drop in domestic demand. That is, financial problems have had devastating real effects. Each of these effects reverberates around the world, some compounding and some offsetting each other.

Governments have responded with an easing of monetary and fiscal policy that in turn have their own effects on activity and financial and trade flows. The downturn in activity is causing

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[1] OECD 2009
   http://www.oecd.org/document/12/0,3343,en_2649_37431_42788172_1_1_1_1,00.html

unemployment to rise sharply and, with it, a political response to protect domestic industries through various combinations of domestic subsidies and border protection. There is potential for protectionism to rise further.

Both the causes of the crisis and the policy responses are reshaping the level and pattern of world trade. The objective of this study is to disentangle the various direct and indirect effects of the crisis on international trade and how events might unravel. To do this, a dynamic, intertemporal general equilibrium model that fully integrates the financial and real sectors of the economy is used to unravel and understand the mechanisms at work. The model incorporates wealth effects, expectations and financial markets for bonds, equities and foreign exchange as well as trade and financial flows. It is a suitable tool to analyse the impact of the crisis and policy responses on global trade and financial flows.

The paper is organised as follows. In the next section, the main linkages and mechanisms by which the financial crisis affects trade is given. This is necessary on two counts: it sets up the modelling approach and it also serves as a basis for developing the shocks to be imposed on the model that represent the financial crisis. The main features of the G-Cubed model that is used in this analysis are described briefly as the model is documented in full elsewhere.

In section 3, the simulations to represent the financial crisis are described and the justification for the size of the shocks chosen. It turns out six shocks are needed: three for the crisis itself and three for the subsequent policy responses which covers monetary and fiscal stimulus as well as the trade protectionism that has emerged.

Results are then discussed in two separate parts to disentangle the various macroeconomic influences on world economies including trade. In section 4 the effects of the crisis on world economies without the fiscal policy responses, that is the first three simulations, are described. Then in section 5, the results from the three policy responses are described on their own to gauge their relative impacts. Finally, in section 6, some of the main insights are highlighted and discussed.

2. How the financial crisis has affected trade outcomes

The mechanisms at work

The financial crisis has affected trade outcomes through several channels, some obvious, some less so. One obvious one is the slowdown in demand both by business and households. As households spend less so imports will fall, and hence someone else's exports will fall. But other effects are more complicated as set out in chart 2.1.

A financial crisis causes a sharp reappraisal of risk by households and business. With any loss of confidence, banks are no longer happy to lend at the same rates as before, if they lend at all. Trade credit under these circumstances is harder to come by. Such upward reappraisals of risk cause the cost of capital to rise and, with widespread uncertainty, countries become reluctant to lend to other countries. Therefore capital flows shrink and this means current account deficits and surpluses will contract. Such changes in current account balances affect trade balances

and hence exports and imports. Facilitating all these adjustments will be changes in real exchange rates that affects the relative price of tradeables and non-tradeables and hence the supply and demand of exports and imports.

Falling output, trade and employment leads to unpleasant social consequences and so causes policy makers to counteract the effects and stimulate the economy. There are three ways policy makers look after their constituents. One is to ease monetary policy. Another is to stimulate domestic demand through expansionary fiscal policy. This can occur through hand-outs to households via tax breaks or direct payments, by extra government spending, often on infrastructure, or subsidies to producers, such as car makers. Extra spending by governments means extra borrowing in the first instance and this affects capital flows and trade once again. The third way governments sometimes choose to 'look after their own' is by protection: either by overt border measures such as tariff increases or more subtle ones such as "Buy Local" programs. Financial protection, for example where banks or firms are directed to lend at home, can also occur. Financial protection will affect relative rates of return and hence capital flows and trade.

All of the above mechanisms affect trade. Some will compound each other, others will be offsetting. The only to understand some of the key drivers is by use of a model as set out below.

2.1 **The main mechanisms affecting trade outcomes**

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                    ┌─────────────────┐
                    │   Financial     │
                    │     crisis      │
                    └────────┬────────┘
                             │
                             ▼
                    ┌─────────────────────┐
                    │ Risk premiums rise, │
                    │ cost of capital rises,│
                    │ credit costs increase,│
                    │ asset prices fall   │
                    └─────────────────────┘
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- Investment falls
- household consumption falls

Capital flows change

Cost of trade credit rises

Domestic demand falls

Exchange rates change

- Imports fall
- Exportable supply potential rises

Net exports rise or fall

Net exports shrink

Direct effects

Trade outcomes

Import demand rises

Capital flows and exchange rates change

Imports fall

Leads to:

Domestic stimulus to domestic demand

- Government borrowing
- Monetary easing
- Financial protectionism

Trade protectionism

Policy responses

The model

The G-Cubed model is an intertemporal general equilibrium model of the world economy. The theoretical structure is outlined in McKibbin and Wilcoxen (1998)[2]. A number of studies—summarized in McKibbin and Vines (2000)—show that the G-cubed modelling approach has been useful in assessing a range of issues across a number of countries since the mid-1980s.[3] Some of the principal features of the model are as follows:

- The model is based on explicit intertemporal optimization by the agents (consumers and firms) in each economy[4]. In contrast to static CGE models, time and dynamics are of fundamental importance in the G-Cubed model. The MSG-Cubed model is known as a DSGE (Dynamic Stochastic General Equilibrium) model in the macroeconomics literature and a Dynamic Intertemporal General Equilibrium (DIGE) model in the computable general equilibrium literature.

- In order to track the macro time series, the behavior of agents is modified to allow for short run deviations from optimal behavior either due to myopia or to restrictions on the ability of households and firms to borrow at the risk free bond rate on government debt. For both households and firms, deviations from intertemporal optimizing behavior take the form of rules-of-thumb, which are consistent with an optimizing agent that does not update predictions based on new information about future events. These rules-of-thumb are chosen to generate the same steady state behavior as optimizing agents so that in the long run there is only a single intertemporal optimizing equilibrium of the model. In the short run, actual behavior is assumed to be a weighted average of the optimizing and the rule-of-thumb assumptions. Thus aggregate consumption is a weighted average of consumption based on wealth (current asset valuation and expected future after tax labor income) and consumption based on current disposable income. Similarly, aggregate investment is a weighted average of investment based on Tobin's q (a market valuation of the expected future change in the marginal product of capital relative to the cost) and investment based on a backward looking version of Q.

- There is an explicit treatment of the holding of financial assets, including money. Money is introduced into the model through a restriction that households require money to purchase goods.

- The model also allows for short run nominal wage rigidity (by different degrees in different countries) and therefore allows for significant periods of unemployment depending on the labor market institutions in each country. This assumption, when taken together with the explicit role for money, is what gives the model its "macroeconomic" characteristics. (Here again the model's assumptions differ from the standard market clearing assumption in most CGE models.)

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[2] Full details of the model including a list of equations and parameters can be found online at: www.gcubed.com

[3] These issues include: Reaganomics in the 1980s; German Unification in the early 1990s; fiscal consolidation in Europe in the mid-1990s; the formation of NAFTA; the Asian crisis; and the productivity boom in the US.

[4] See Blanchard and Fischer (1989) and Obstfeld and Rogoff (1996).

- The model distinguishes between the stickiness of physical capital within sectors and within countries and the flexibility of financial capital, which immediately flows to where expected returns are highest. This important distinction leads to a critical difference between the quantity of physical capital that is available at any time to produce goods and services, and the valuation of that capital as a result of decisions about the allocation of financial capital.

As a result of this structure, the G-Cubed model contains rich dynamic behaviour, driven on the one hand by asset accumulation and, on the other by wage adjustment to a neoclassical steady state. It embodies a wide range of assumptions about individual behaviour and empirical regularities in a general equilibrium framework. The interdependencies are solved out using a computer algorithm that solves for the rational expectations equilibrium of the global economy. It is important to stress that the term 'general equilibrium' is used to signify that as many interactions as possible are captured, not that all economies are in a full market clearing equilibrium at each point in time. Although it is assumed that market forces eventually drive the world economy to neoclassical steady state growth equilibrium, unemployment does emerge for long periods due to wage stickiness, to an extent that differs between countries due to differences in labor market institutions.

In the version of the model used here there are 6 sectors (energy, mining, agriculture, manufacturing durables, manufacturing non-durables and services) and 15 countries/regions as set out in Table 2.2.

2.2 **Countries/regions**

United States	China
Japan	India
United Kingdom	Other Asia
Germany	Latin America
Euro Area	Other LDC
Canada	East Europe & Former Soviet Union
Australia	OPEC
Rest of OECD	

3. Simulating the effects of the crisis

Events leading up to the crisis in 2008— the baseline

The focus of this study is on disentangling the many influences of the financial crisis on trade outcomes. The 'crisis' is defined here as the bursting of the housing market bubble in late 2007, the ensuing collapse in the sub-prime mortgage market and related financial markets and the subsequent collapse of Lehman Brothers in 2008 which resulted in a sharp increase in risk premia around the world. The effect of the financial crisis on global trade is therefore the difference between a world where there was no crisis and one where there is. That is, to assess the effects of the crisis on trade, a baseline, or "business as usual", view of a world without a crisis has to be produced.

There are two aspects to this baseline. One is the exogenous productivity and population trends going forward and the other is the underlying imbalances brewing in the world economy prior to the financial crisis itself. We assume that tax rates and the shares of government spending devoted to each commodity remain unchanged. In the G-Cubed model, projections are usually made based on a range of input assumptions. There are two key inputs into the growth rate of each sector in the model. The first is the economy wide population projection which differs by country according to the UN mid- projection. The second is the sectoral productivity growth rates. How the sectoral productivity growth rates are calculated is a little detailed so is set out in Appendix A. In the long run we take the underlying long-run rate of world population growth plus productivity growth to be 1.8 percent per annum, and take the long-run real interest rate to be 4 percent.

The second aspect of a baseline is some of the prior events to the crisis. The problem is that some of the seeds of the financial crisis were sown in the decade before the crisis. A series of large global events, such as the bursting of the dotcom bubble in 2001 and the rapid growth of China, were already reshaping the pattern and level of world trade before the 2007-2008 financial crisis hit. Some of these events, like the large disparities between savings and investment in China (a surplus) and in the United States (a deficit) led to large differences between exports and imports for each nation so that large current account surpluses were accumulating in China and large deficits in America. Some people[5] attribute these growing global imbalances as contributing causes of the crisis, and there is some truth in that. But the focus of this study is on the impact of the crisis itself on world trade and not on trying to disentangle the various contributing factors to the crisis, as important as that issue is.

Therefore, besides population and productivity trends shaping the baseline for the world, some of the key events over the last decade influencing the baseline would be:

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[5] For example, see Max Corden, *The world credit crisis: understanding it and what to do,* http://www.melbourneinstitute.com/wp/wp2008n25.pdf and Martin Wolf, *How imbalances led to credit crunch and inflation,* Financial Times, June 17 2008.

- First, there was the Asian financial crisis of 1997-98, which saw Asian economies generate large current account surpluses that had to be invested offshore to keep their nominal exchange rates low. Capital flowed out of Asia into US dotcom stocks driving up equity prices.

- Next was the bursting of the dotcom bubble, which saw the booming NASDAQ over 1998–2000 burst in 2001.

- Fearing a downturn and possible deflation, the US Federal Reserve eased monetary policy in 2001 in a series of steps to 2004. Some argue that they eased too much for too long[6].

- But, with easy credit and a rising housing market, a boom in house prices followed and a period of high growth in credit and leveraged loans. Risk premia hit low levels and leveraged deals became common as investors chased yields in an environment of lax regulatory oversight.

- Rising demands from China (and, to some extent, India), plus a booming world economy saw commodity prices rise across oil, minerals and food from late 2004 to late 2007. The shock to the global economy from this commodity price boom was as big as the first oil shock in the 1970s.

- Rising prices and inflation caused monetary authorities to tighten policy from mid-2004 to June 2006.

Each of these major events set up their own dynamics for the course of the world economy and helped shape the underlying baseline. Some of these events such as the easing and tightening of monetary policy are endogenous to the model and already incorporated in the baseline. It is important to appreciate that the results reported here are *deviations* from baseline from the financial crisis, as defined here. What is important is the relative contribution of different effects and to disentangle the impacts of the financial crisis on trade outcomes.

The six shocks to represent the crisis and the policy responses

The above events have led to the now well known global downturn. All official forecasting agencies, such as the IMF and OECD, have described this downturn and so will not be expanded here. As the IMF notes 'Global GDP is estimated to have fallen by an unprecedented 5 percent in the fourth quarter (annualized), led by advanced economies, which contracted by around 7 percent' [7]. Japan has been particularly hard hit with a fourth quarter GDP (2008) plummeting by 13 percent. Demand for durable goods has been particularly hard hit. With the downturn there has been a sharp upturn in savings by households (and commensurate reduction in consumption), driven by a reappraisal of risk by households and a loss of net worth

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[6] Notably John Taylor, see Taylor, J.B. 2008, *The Financial Crisis and the Policy Responses: An Empirical Analysis of What Went Wrong.*

[7] IMF 2009, *Group of Twenty, Meeting of the Ministers and Central Bank Governors March 13-14, 2009, London UK,* p. 4.

with falling house prices and equity prices. So shocks need to be devised to account for three things;

- The bursting of the housing bubble and loss in asset prices and household wealth with consumers cutting back on spending and lifting savings.

- A sharp reappraisal of risk with a spike in bond spreads on corporate loans and interbank lending rates with the cost of credit, including trade credit, rising with a commensurate collapse of stock markets around the world.

- A massive policy response including a monetary policy easing, bailouts of financial institutions and fiscal stimulus. Also, signs of emerging trade and financial protectionism appear.

These three outcomes can be represented by six shocks — three for the crisis itself and three for the policy response.

Three main shocks capture the onset of the global financial crisis:

1. The bursting of the housing bubble causing a reallocation of capital and a loss of household wealth and drop in consumption.

2. A sharp rise in the equity risk premium (the risk premium of equities over bonds) causing the cost of capital to rise, private investment to fall and demand for durable goods to collapse.

3. A reappraisal of risk by households causing them to discount their future labor income and increase savings and decrease consumption.
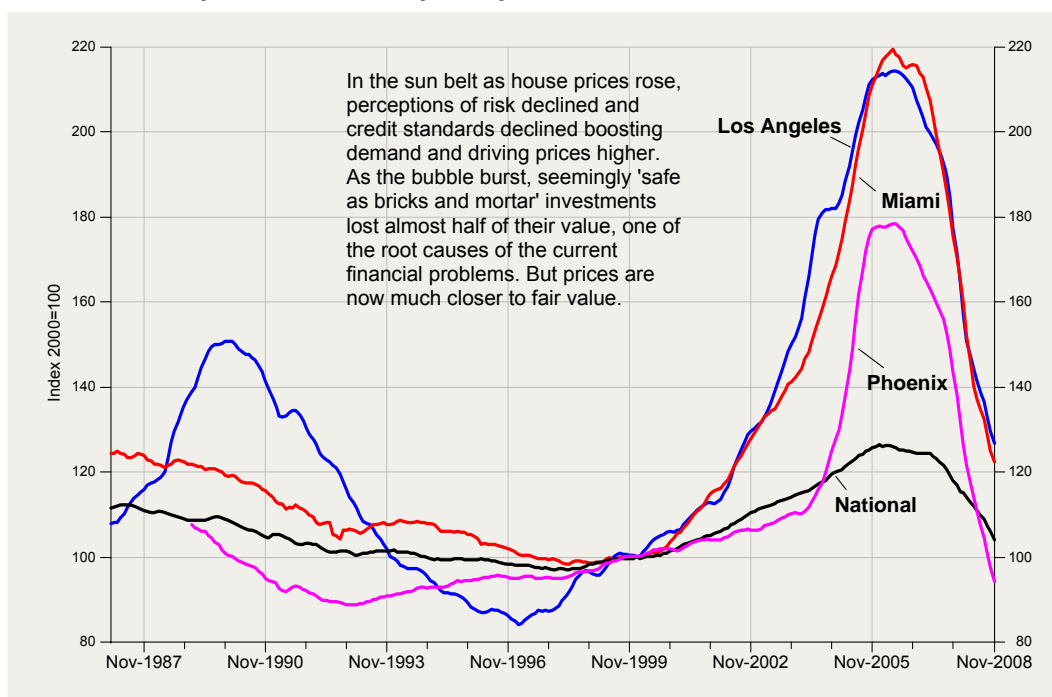
Shock 1: The bursting of the housing bubble

Falling house prices had a major effect on household wealth, spending and defaults on loans held by financial institutions. Events in the United States typify a global phenomenon. From 2000 to 2006, house prices in some areas doubled to subsequently collapse (chart 3.1). These changes in some areas have generated dramatic news headlines but, overall the United States index of house prices has fallen by 6.2 percent in real terms from the 1st quarter 2008 to the same quarter in 2009 [8].

While house prices were rising so strongly, credit was supplied liberally to meet the demand as perceptions of risk fell. The rising wealth boosted confidence and spending. The housing bubble was a global phenomenon centered mainly on the Anglo-Saxon world.

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[8] Federal Housing Finance Agency May 2009, http://www.fhfa.gov/webfiles/2406/1q09hpi.pdf

3.1 **US house prices relative to per capita household income**

In the sun belt as house prices rose, perceptions of risk declined and credit standards declined boosting demand and driving prices higher. As the bubble burst, seemingly 'safe as bricks and mortar' investments lost almost half of their value, one of the root causes of the current financial problems. But prices are now much closer to fair value.

Index 2000=100

Los Angeles

Miami

Phoenix

National

a Notes: Series shown are house prices over per capita household income. For comparison series are indexed to a common base 2000=100. Individual cities are from the S&P Case Schiller index. National prices are from the OFHEO. OFHEO data has a complete coverage of the US while the Case Schiller index only covers the largest 20 cities. OFHEO and Case Schiller data for individual cities indicate similar movements – i.e. differences in the series largely reflect the coverage differences. (The widely reported Case Schiller index shows much larger falls than the OFHEO index.)

Data source: Standard and Poors, Office of Housing Enterprise Oversight, OECD Economic Outlook Database.

The housing bubble was the result of a long period of low interest rates by the US Federal Reserve. The Federal Reserve cut interest rates by a total of 550 basis points in a series of steps between 2001 and 2004. The easing, subsequent tightening and current easing are shown in chart 3.2. Some believe (for example the 'Austrian school' and John Taylor[9]), that monetary policy was too loose for too long and this is what gave rise to the asset price bubble and commodity price spike. Taylor argues that had the Federal Reserve followed the Taylor rule (actually the Henderson-McKibbin-Taylor rule), interest rates would have risen much sooner and the bubbles n would not have appeared to the same extent (chart 3.2).

3.2 **Federal funds rate** Actual and counterfactual
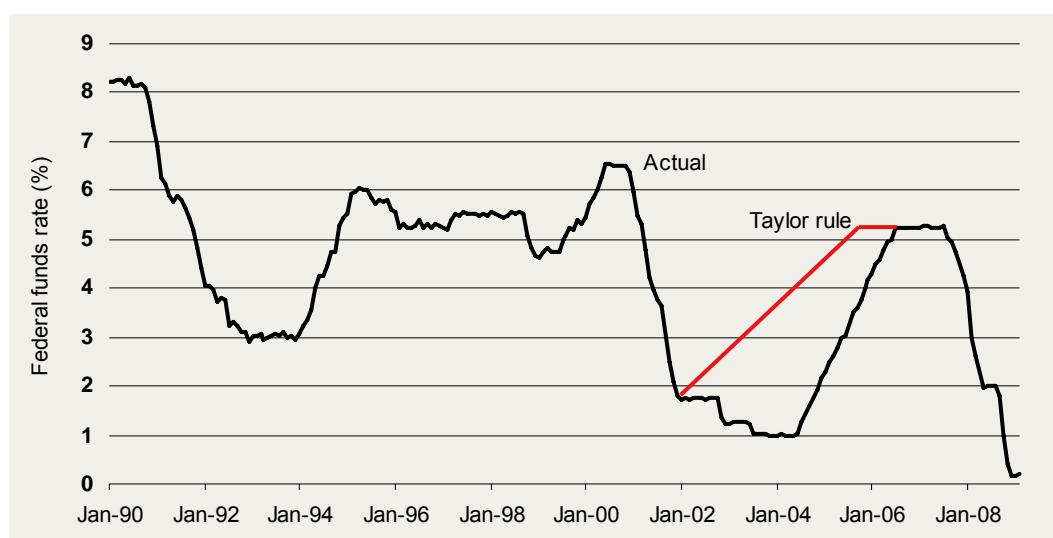
Note: The daily effective federal funds rate is a weighted average of rates on brokered trades. Weekly figures are averages of 7 calendar days ending on Wednesday of the current week; monthly figures include each calendar day in the month. Annualised using a 360-day year or bank interest.
Data source: US Federal Reserve Statistical Release, http://www.federalreserve.gov/releases/h15/data/Monthly/H15_FF_O.txt, Accessed 5 March 2009.

While low interest rates were due to fears of deflation[10] and led to a boom in US housing, low interest rates were not just the result of the Fed's actions. US bond yields were also low because of low world rates (with Japanese bond yields at a little over 1 percent and short term interest rates at zero). There was also an international aspect to low US interest rates with Japan and Europe only recovering very slowly from the 2000-01 downturn and in turn placing pressure on the US to keep interest rates low. In Japan there were fears of re-emergent deflation. That is the principal reason why interest rates were kept low in the US for an unusually long term — until mid-2004 when the Fed began a very sharp tightening cycle[11]. The low interest rates through 2003-04 — besides fuelling a boom in bank lending, rising asset

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[9] Taylor, J.B. 2008, *The Financial Crisis and the Policy Responses: An Empirical Analysis of What Went Wrong*, p. 2.

[10] For example, see Alan Greenspan's account in T*he Age of Turbulence,* Allen Lane, 2007, pp228-229.

[11] The sharpest, in fact, since the Volker deflation of the early 1980s.

prices and rising demand in China and other developing countries — also fuelled a commodity price boom.

However, only a part of the dwelling boom and the commodity boom can be attributed to the actions of the Fed. The up-trend in US house prices was evident as early as 2000. As small investors abandoned the stock market in 2001, they dived into the housing market, driving up and sustaining the price rises. Similarly, the surge in commodity prices through 2005 to 2008, which took most analysts by surprise, had as much to do with developments in China, and the lagged response of supply, as they did with an increase in demand in North America. Where the real problem lay was in the combination of the two.

The bursting of the housing bubble is modelled as a surprise fall in the expected flow of services from housing investment – larger in the United States, United Kingdom and Europe but still significant throughout the world. In the model, the household in each economy is modelled as solving an intertemporal consumption problem subject to an intertemporal budget constraint. The result is a time profile for the consumer in each country of consumption of goods from all countries based on expected future income and expected relative goods prices. The household also chooses investment in a capital good. The household capital stock combines housing, and other durable goods. For simplicity of exposition we will refer to this capital good as "housing" from here on.

The investment decision by households is modelled analogously to how we model the investment decisions of firms within an intertemporal framework subject to adjustment costs for capital accumulation. The household invests in housing to maximize consumption from the stream of future service flows that housing provides. This stream of services is analogous to a production function based on inputs of capital and a productivity term. We model the housing part of the crisis as a fall in the productivity of the service flow from the housing stock. This fall in expected future productivity of housing means that the Tobin's q for housing drops when the shock occurs. The drop in housing productivity in the United States is assumed to be 10 percent lower in 2009 and is calibrated to give, along with the other shocks, a drop in house prices in the US of the order of 6 percent, roughly what has been observed for the last year[12]. A plausible scenario is where productivity returns to 'normal' by 2013.

Shock 2: Rising equity risk premia

The surprise up-swing in commodity prices from 2003 but most noticeable during 2006 and 2007 led to concerns about inflation leading to the sharp reversal in monetary policy in the US. This tightening in US policy also implied a tightening of monetary policy in economies that pegged to the US dollar. It was the sharpness of this reversal as much as

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[12] A 10 percent permanent drop in housing productivity in the United States alone gives a 5.4 percent drop in housing values one year later. See McKibbin, W and Stoeckel, A, *Bursting of the US housing Bubble*, Economic Scenarios No 14, www.economicscenarios.com.

3.3 **The Lehman Brothers' bankruptcy and risk premia**
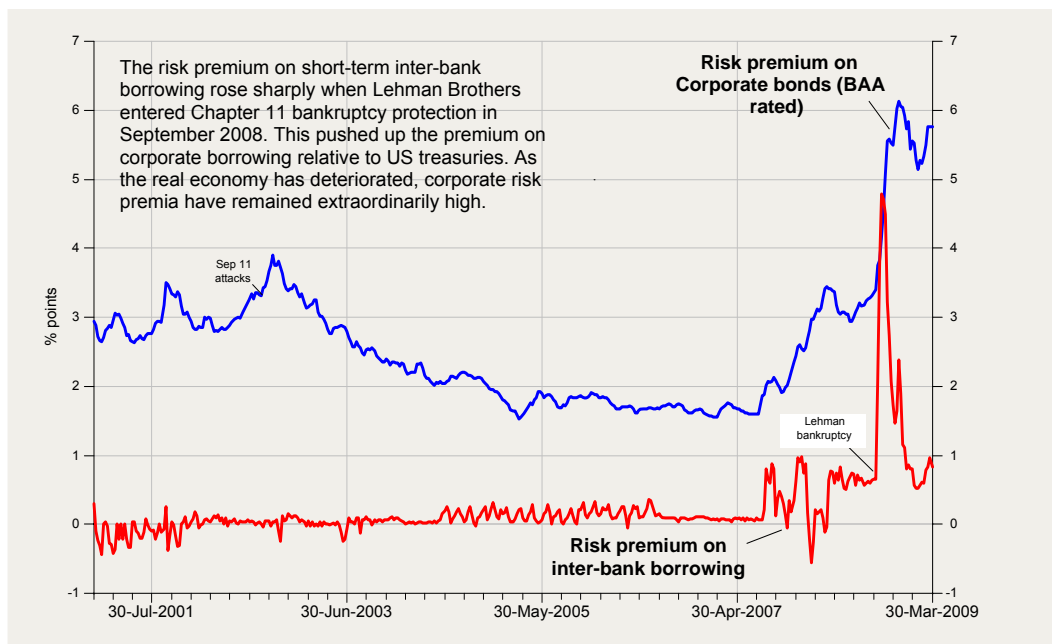
a Notes: Weekly data. Risk premium on inter-bank borrowing approximated by the rate on one month Euro-dollar deposits less the Federal funds rate. Risk premium on corporate bonds measured as the yield on BAA rated corporate bonds less the 10 year Treasury bond yield. *Data source:* Federal Reserve Board.

the fall in US house prices and the failures of financial regulation (for example, the mortgage underwriters Fannie Mae and Freddie Mac) that led to the financial problems for 2008-09[13]. Lehman Brothers' failure was primarily due to the large losses they sustained on the US subprime mortgage market. Lehman's held large positions in the subprime and other lower-rated mortgage markets. But mortgage delinquencies rose after the US housing price bubble burst in 2006-07. In the second fiscal quarter 2008, Lehman reported losses of $2.8 billion. It was forced to sell off $6 billion in assets[14]. The failure of Lehman Brothers in September 2008 and effect on risk premiums across markets can be seen clearly on chart 3.3.

The rise in the equity risk premium since the collapse of Lehman Brothers has been of the order of 8 percentage points. A plausible scenario where confidence is gradually restored so things are back to 'normal' by 2013 is therefore assumed.

– Under this scenario, balance sheets of financial institutions are gradually restored through existing and new programs to address distressed assets. Combined with new capital raising, confidence and lending returns. Also, investors learn to live with the 'new world' and economic recovery encourages new investment and a virtuous circle of further improvements in confidence.

[13] Similarly, the tightening cycle of the mid-1980s was one factor leading to the Savings and Loan crisis.

[14] *New York Times*, Thursday, 26 February 2009.

– This scenario is plausible in the opinion of the authors. The world will recover but the size and speed of the drop in economic activity has been a salutary lesson for investors who are not likely to forget that quickly. So, to capture the collapse of commodity prices and the financial sector, an initial rise in the equity risk premium of 8 percentage points for the United States is taken for the six sectors in the model: the energy, mining, agriculture, durable and non durable manufacturing and services sectors in 2009 and then dissipates in equal steps over the next four years but staying permanently higher by 2 percent from 2012. The permanent rise in the risk premium reflects the baseline risk premium which is assumed to be close to zero in the projection based on the experience from 2003. Thus there is an overshoot in the return to "normal".

Shock 3: A rise in household risk

The reappraisal of risk by firms as a result of the crisis also applies to households. As households view the future as being more risky, so they discount their future earnings and that affects their savings and spending decisions. The increase in household risk in the United States is assumed to be 3 percentage points in the 'plausible' scenario in 2009, half that in 2010 and back to 'normal' in 2011 and thereafter.

Summary of three crisis shocks and country differences

The three shocks by sector the United States are shown in table 3.4.

3.4 **Equity risk premium, household risk and housing productivity for the United States under the plausible scenario**

	2009	*2010*	*2011*	*2012*	*2013*	*…beyond 2014*
Plausible scenario						
Equity risk premium by sector:						
– Energy	8	6	4	2	2	2
– Mining	8	6	4	2	2	2
– Agriculture	8	6	4	2	2	2
– durable manufacturing	8	6	4	2	2	2
– non durable manufacturing	8	6	4	2	2	2
– services	8	6	4	2	2	2
Household risk	3	1.5	0	0	0	0
Housing productivity	-10	-8	-6	-4	-4	-4

Source: authors' calculations.

The shocks in table 3.4 are for the United States — the 'epicentre' of the crisis. But not all countries have been equally affected by the crisis. For example, durable manufacturing in Japan would be hit harder by the risk reappraisal given the collapse of their durable exports

(dominated by cars) as a result of the combination of the global downturn and the appreciation of the Yen that resulted from the collapse in commodity prices and improvement in their terms of trade.

Also, Japan had their housing bubble a decade earlier than did the United States, so over the last few years they never experienced a property bubble as in America. So the shock to their economy from the bursting of the housing bubble would be less than for the United States. Therefore the shocks for equity risk, the housing bubble bursting and household risk are scaled off the United States. Taking the United States as 1 a series of weights for other sectors and economies appears in table 3.5.

3.5 Weight for country and sector shocks

	USA	JPN	GBR	DEU	EUR	CAN	AUS	OEC	CHI	IND	OAS	LAM	LDC	EEB	OPC
Equity risk by sector															
– energy	1	1	1	1	1	1	1	1	0.8	0.8	0.8	0.8	0.8	0.8	0.8
– mining	1	1	1	1	1	1.2	1.2	1	0.8	0.8	0.8	0.8	0.8	0.8	0.8
– agriculture	1	1	1	1	1	1	1	1	0.8	0.8	0.8	0.8	0.8	0.8	0.8
– durable manufacturing	1	1.2	1	1.2	1	1	1	1	0.8	0.8	0.8	0.8	0.8	0.8	0.8
– non durable manufacturing	1	1	1	1	1	1	1	1	0.8	0.8	0.8	0.8	0.8	0.8	0.8
– services	1	1	1.2	1	1	1	1	1	0.8	0.8	0.8	0.8	0.8	0.8	0.8
Household risk	1	0.3	1	0.5	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Household productivity	1	0.1	1	0.5	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5

Three main shocks capture the policy responses

On top of the above three financial crisis shocks there has been an unprecedented policy response comprising three more elements:

4. An easing of monetary policy to near zero official rates of interest in major developed economies.

5. An easing of fiscal policy across countries and large run-up in government deficits.

6. A rise in trade and financial protectionism.

Shock 4: Monetary easing

There is an endogenous monetary response in the model for each economy where each economy follows a Henderson-McKibbin-Taylor rule as shown in equation (1) with different

weights on inflation (π) relative to target, output growth (Δy) relative to potential and the change in the exchange rate (Δe) relative to target.

$$i_t = i_{t-1} + \beta_1(\pi_t - \pi_t^T) + \beta_2(\Delta y_t - \Delta y_t^T) + \beta_3(\Delta e_t - \Delta e_t^T) \qquad (1)$$

The assumed parameter values are set out in Table 3.6. Note that China and most developing economies have a non- zero weight on the change in the $US exchange rate. The monetary easing that has occurred is close to the endogenous monetary policy response already built into the model so any extra monetary stimulus is not required. Of course it is possible that authorities, being fearful of raising interest rates too early and pricking the nascent recovery, could end up easing too much for too long and would be an interesting simulation, especially if different countries chose different amounts of 'over-easing' which would set up capital flow changes and hence trade flow changes.

3.6: **Coefficients in Henderson-McKibbin-Taylor Rules in Each Country**

	inflation (β1)	output growth (β2)	$US Exchange rate (β3)
USA	0.5	0.5	0
JPN	0.5	0.5	0
GBR	0.5	0.5	0
DEU (*)	0.5	0.5	0
EUR (*)	0.5	0.5	0
CAN	0.5	0.5	0
AUS	0.5	0.5	0
OEC	0.5	0.5	0
CHI	0.5	0.5	-1
IND	0.5	0.5	0
OAS	0.5	0.5	-1
LAM	0.5	0.5	-1
LDC	0.5	0.5	-1
EEB	0.5	0.5	-1
OPC	0.5	0.5	-10
(*) Note that Germany (DEU) and the rest of the Eurozone (EUR) have a common interest rate with a weight on European wide inflation and output gap.			

Shock 5: Fiscal easing

There is an endogenous fiscal policy response in the model but the rule is a targeting of fiscal deficits as a percent of GDP. The easing of fiscal policy announced by most economies has been an extra unprecedented stimulus in the modern era and expansion of fiscal deficits and has to be simulated.

The discretionary stimulus packages announced by each country has mainly occurred over 2009 and 2010 and is usefully summarised by the OECD[15]. For the United States the

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[15] OECD 2009, *Fiscal Packages Across OECD Countries: Overview and Country Details*, Paris, 31 March.

cumulative stimulus is nearly 5 percent of GDP and for China it is over 11 percent of GDP. It is unlikely that such a stimulus will suddenly end in 2010 for two reasons: it is hard to crank up government spending on things like infrastructure quickly and governments usually find it hard to reign in spending quickly once programs are announced. Therefore, whilst assuming the same cumulative fiscal response as outlined by the OECD and other studies, the fiscal response has been assumed to taper off quickly after 2010 but finishing in 2012. The assumed fiscal response is outlined in table 3.7.

3.7   **The assumed fiscal policy response** percent of GDP

Country/region	2009	2010	2012	2013	Cumulative
United States	2.07	1.55	1.04	0.52	5.18
Japan	1.46	1.10	0.73	0.37	3.65
United Kingdom	1.32	0.99	0.66	0.33	3.29
Germany	1.38	1.04	0.69	0.35	3.45
Euro area	1.30	0.98	0.65	0.33	3.25
Canada	1.68	1.26	0.84	0.42	4.20
Australia	2.48	1.86	1.24	0.62	6.21
Rest of OECD	1.00	0.75	0.50	0.25	2.50
China	4.80	3.60	2.40	1.20	12.00
India	0.50	0.38	0.25	0.13	1.25
Other Asia	2.00	1.50	1.00	0.50	5.00
Latin America	0.50	0.38	0.25	0.13	1.25
Other LDC	0.50	0.38	0.25	0.13	1.25
EEFSU	1.70	1.28	0.85	0.43	4.25
OPEC	3.00	2.25	1.50	0.75	7.50

Source: OECD 2009 and authors' calculations.

Shock 6: Rise in trade and financial protectionism

Rising trade protectionism is a real threat. It occurred during the Great Depression and is attributed with making matters far worse. The main driver for this protectionism was to protect jobs. The Smoot-Hawley legislation in the United States at the time of the Great Depression saw tariffs increase and help trigger the beggar-thy-neighbour round of tariff increases by other countries. Could it happen again?

The answer is that it has already started, albeit on a small scale so far. At the G-20 meeting in November last year, leaders affirmed their commitment to open trade and declared they would not put up more barriers. Yet within 36 hours, India and Russia, two attendees at the summit

had put up some trade barriers[16]. Just about every major, and minor car producer for that matter, has given its domestic industry various concoctions of subsidies, grants and soft loans. President Obama was implored to weed out the 'Buy American' provisions in his fiscal stimulus package. Although 'softened', it got through.

It is worth remembering that at the time of the introduction of the Smoot-Hawley tariff during the Great Depression, over 1000 economists petitioned about the harm the legislation would cause. Smoot-Hawley was nevertheless signed into law. Such is the power of politics. Actually there are two political problems. One is the obvious loss of jobs and ability of narrow vested interest groups to look after themselves in times of crisis at the expense of the common good.

The other political problem is the free-rider one. It goes as follows. When all countries are affected by the downturn, monetary policy is far less effective because all countries cannot devalue against each other. And with the drastic loss of confidence, business is reluctant to borrow and invest irrespective of the level of interest rates. Hence countries have to rely on fiscal stimulus to encourage a recovery. But it is tempting for countries to free ride on others like the United States, who need to implement big fiscal stimulus packages, part of which will spill over to imports. Taxpayers, bearing the future burden of the fiscal stimulus, naturally want to get the 'biggest bang for their buck' but wrongly think that is achieved by keeping the spending at home. Hence the 'Buy American' provisions in their stimulus bill. Other countries, most recently China, have followed suit[17]. But if there is global co-ordination of proportionally similar stimulus packages, most of the leakage washes out as gains elsewhere. Some of the protectionist sentiment is a result of a lack of global coordination of policy.

WTO members are only legally required to not increase tariffs above their 'bound' rates. However there can be special exemptions invoked and there are ways to impose protection that raise effective rather than observed tariff rates.

Rising financial protectionism is a real threat as well and has already been observed. For example, some countries, faced with undercapitalized banks unwilling to lend on the same basis as before the crisis and with taxpayers shoring up bank reserves, have directed their banks to lend locally. Other restrictions on foreign bank operations are bound to emerge in the regulatory aftermath that is now following the crisis. All of these actions have the effect of widening disparities between rates of return and therefore affect global capital flows and, in turn, trade. But modeling this effect requires estimates of how big this effect might be and, as none are readily available, the effect of financial protectionism has not been included in this analysis. The result is trade impacts from the crisis are likely to be understated.

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[16] Although Russia is not yet a member of the WTO and bound by their laws, they still declared, along with the other G-20 participants, not to increase tariffs.

[17] For example see news report in the Financial times http://www.ft.com/cms/s/0/66454774-5a7c-11de-8c14-00144feabdc0.html

Two potential effects not specifically covered by the six shocks

There are two other potential effects on trade not specifically covered by the simulations. First is that the model is an annual one and while it allows for stock-adjustment dynamics across years, there can be important within-year effects, particularly on trade. The second is the effect of rising interest rates on trade credit. Again while the data in the model has embedded in it the cost of credit on all transactions, trade credit might involve relatively higher costs and could be argued has a depressing effect on international trade.

Inventory cycle and trade

Over the last twenty years, the globalisation of manufacturing production chains and the large increase in global trade has meant that a much greater proportion of inventories in any individual country are imported. Hence a sharp down shift in the inventory cycle from the month of December 2008 onwards has probably been a significant factor behind the sharp downturn in world trade over the first quarter of 2009. It also appears to be a significant factor behind the downward revision of the OECD's forecasts for the global economy since November.

The sharp drop in global sales in December 2008 led to a sharp increase in the stock-to-sales ratio, particularly for OECD economies. Typical of the pattern in the stock-to-sales ratio is highlighted by Japan (chart 3.8). This pattern was repeated internationally with particularly large increases in most major OECD economies. In the Euro area and Japan, in the December 2008 quarter, retailers and manufacturers built up stocks, as the drop in sales caught them by surprise. The opposite was true in countries like the UK, Korea and Australia where inventories were run down relatively quickly.

The large increases in stock to sales ratios in Japan, the Euro area and the rest of the world, will mean that there were significant run downs in stocks in the first half of 2009. These added to the impact of the falls in sales on production.

3.8 **Japanese manufacturing stocks to sales ratio**

Data source: OECD Main Economic Indicators and CIE calculation.

The key feature about the inventory cycle for this study is that it will account for some of the large monthly drops in trade volumes that have generated headline grabbing attention. Year-on-year effects, the focus of this model, are likely to be much less.

Trade credit

At the time of the onset of the financial crisis in September 2008 there was much publicity given to the shortage of credit as banks stopped lending. For example, Auboin from the WTO Secretariat described a $25 billion shortfall in trade credit in November 2008 [18]. A shortage of trade credit would impact on world trade on the supply side but it also seems much of the contraction was a collapse on the demand side as orders were cancelled once business realised they were holding excess inventories as described above. A study by the World Bank estimates the shortfall in trade finance accounting for 10 – 15% of the fall in world trade[19]. Being of small magnitude this effect is omitted from this study.

4. Effects of crisis without a fiscal policy response

[18] Auboin, M, 2009 , *The collapse of global trade, murky protectionism, and the crisis: Recommendations for the G20*, Centre for Economic Policy Research, London.

[19] Reported in International Economics Weekly, *What's happening to world trade? Part II*, 24 April 2009

Mechanisms at work

To appreciate the mechanisms at work from the three shocks an illustrative scenario where shocks affect the United States *alone* is shown in chart 4.1. The bursting of the housing bubble has the biggest negative impact on real consumption, which being roughly 70 percent of the domestic economy, has the biggest negative impact on real GDP. The permanent loss in wealth causes consumption to fall sharply and because the housing shock is assumed to be permanent, consumption is permanently lower in all periods as shown on Chart 4.1.

The financial shock has the largest negative impact on stock market values from baseline in 2009 and an equally large impact as the bursting of the housing bubble on investment. The equity risk shock causes a shift out of equities into other domestic assets, such as housing and government bonds as well as to asset purchases overseas. The shift into government bonds drives up their prices and pushes down real interest rates substantially. This surprisingly raises human wealth because expected future after tax income is discounted at a much lower real interest rate. Thus in the US, the equity shock alone is positive rather than negative for consumption in the short run.

Investment on the other hand falls sharply. The equity shock reduces US investment by about 15 percent below baseline. The rise in equity risk implies a sharp sell-off of shares due to a large rise in the required rate of return to capital. The higher equity risk premium implies that the existing capital stock is too high to generate the marginal product required from the financial arbitrage condition and investment falls and, over time, due to the existence of adjustment costs, the capital stock falls and potential output is permanently reduced.

Under this simulation where the US alone is assumed to be affected by the crisis, there is little impact on US exports (bottom left hand panel of chart 4.1) because there is little net impact on the rest of the world. The negative trade effects are offset by positive effects from United States capital going elsewhere as elaborated below. But as the drop in US consumption hits imports, the trade balance improves over baseline especially in 2009 and remains that way until 2013.

Each of the three shocks has a negative effect on the United States and, combined, has the effect of lowering real GDP by 4 percent below baseline in 2009 and real GDP does not return to baseline until 2017, nearly a decade later. That is sufficient to put the US into recession in 2009 (baseline growth is 3.4 percent) but will allow positive growth in 2010[20].
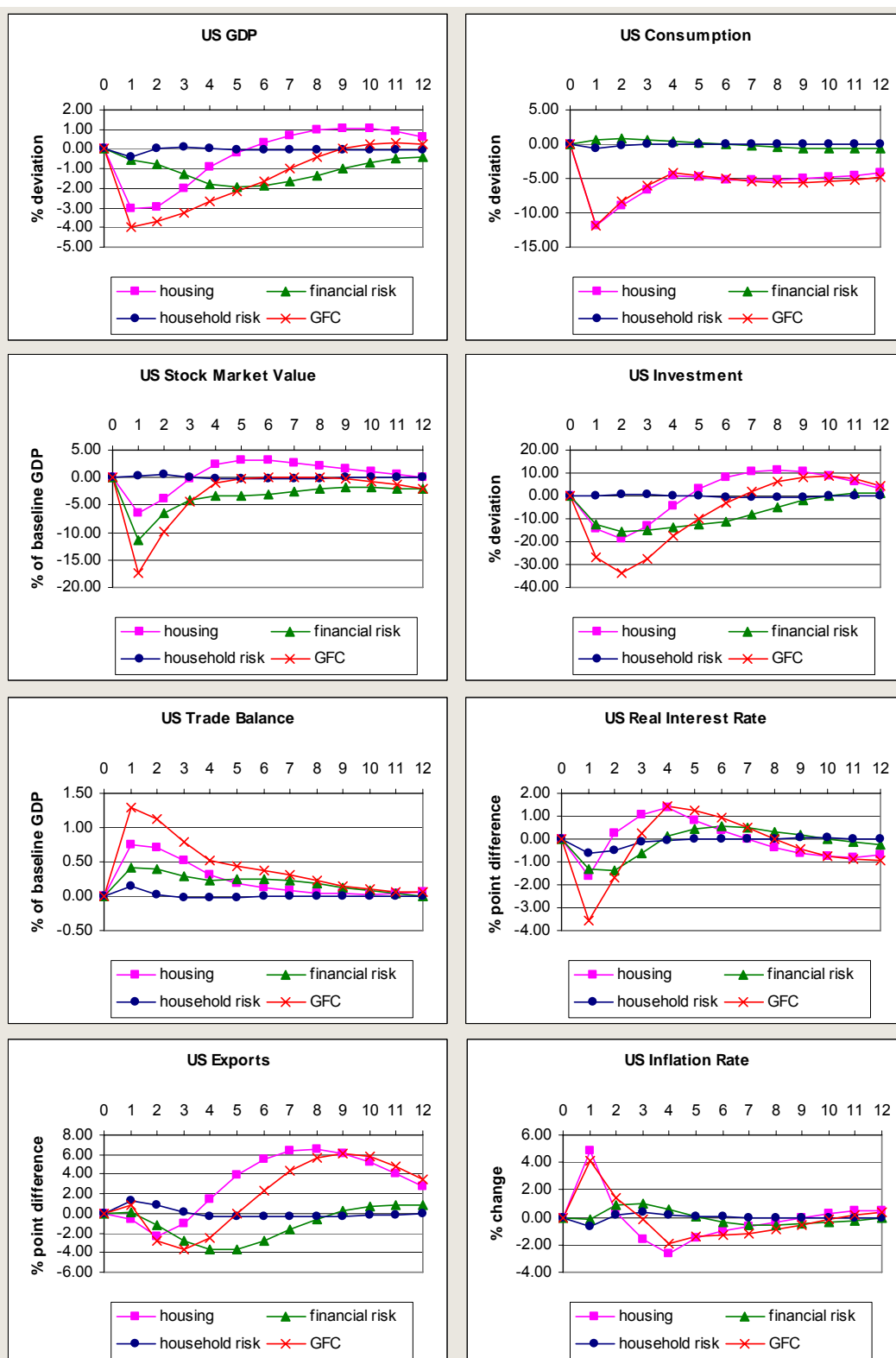
A key compositional effect also occurs when household discount rates rise and risk premia generally rise. The effect is a much sharper fall in the demand for durable goods relative to other goods in the economy. This is shown clearly in Chart 4.2. Imports and domestic production of durable goods fall by more than non durable goods. The differences are

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[20] Note that all results are presented as deviations from a baseline projection. A fall in GDP of 4% in year 1, relative to baseline, where the baseline growth rate was 3% is a new growth rate in the first year of negative 1% (i.e. a recession). If the level of GDP remains 4% lower forever the growth rate of GDP in year 2 is back at baseline growth. Thus in growth rate terms, the crisis is resolved after the first year in many countries although the level of GDP remains below baseline for many years.

substantial. The high risk adjusted cost leads to a reduction in the flow of services from durables and therefore the demand for these goods drops sharply. This compositional effect is critical for the trade outcomes. Countries that export durable goods are particularly affected by a crisis of the type modelled.

The recession in the United States has two main effects on the world economy. One is the negative knock-on effect from the loss in activity with those economies most dependent on the United States market most affected. The second effect runs counter to the first. As prospects dim in the United States, so the returns on investment look better elsewhere. Money flows out of the United States (or strictly in the case of the US, less inflow than otherwise) and into other economies where it stimulates investment and economic activity. This is illustrated by the effect on China (see chart 4.3). The United States is a large importer from China. As US imports fall, China's exports fall (see bottom left hand panel of 4.3), with a combined effect from the three shocks of a drop in

4.1 **Impact of a US only financial crisis on the United States**

US GDP

US Consumption

US Stock Market Value

US Investment

US Trade Balance

US Real Interest Rate

US Exports

US Inflation Rate

Data source: G-Cubed model simulations

4.2 **Impact of a US only financial crisis on Durables verus Non-Durable goods in the United States**

Production and Imports of Durables and Non-Durables

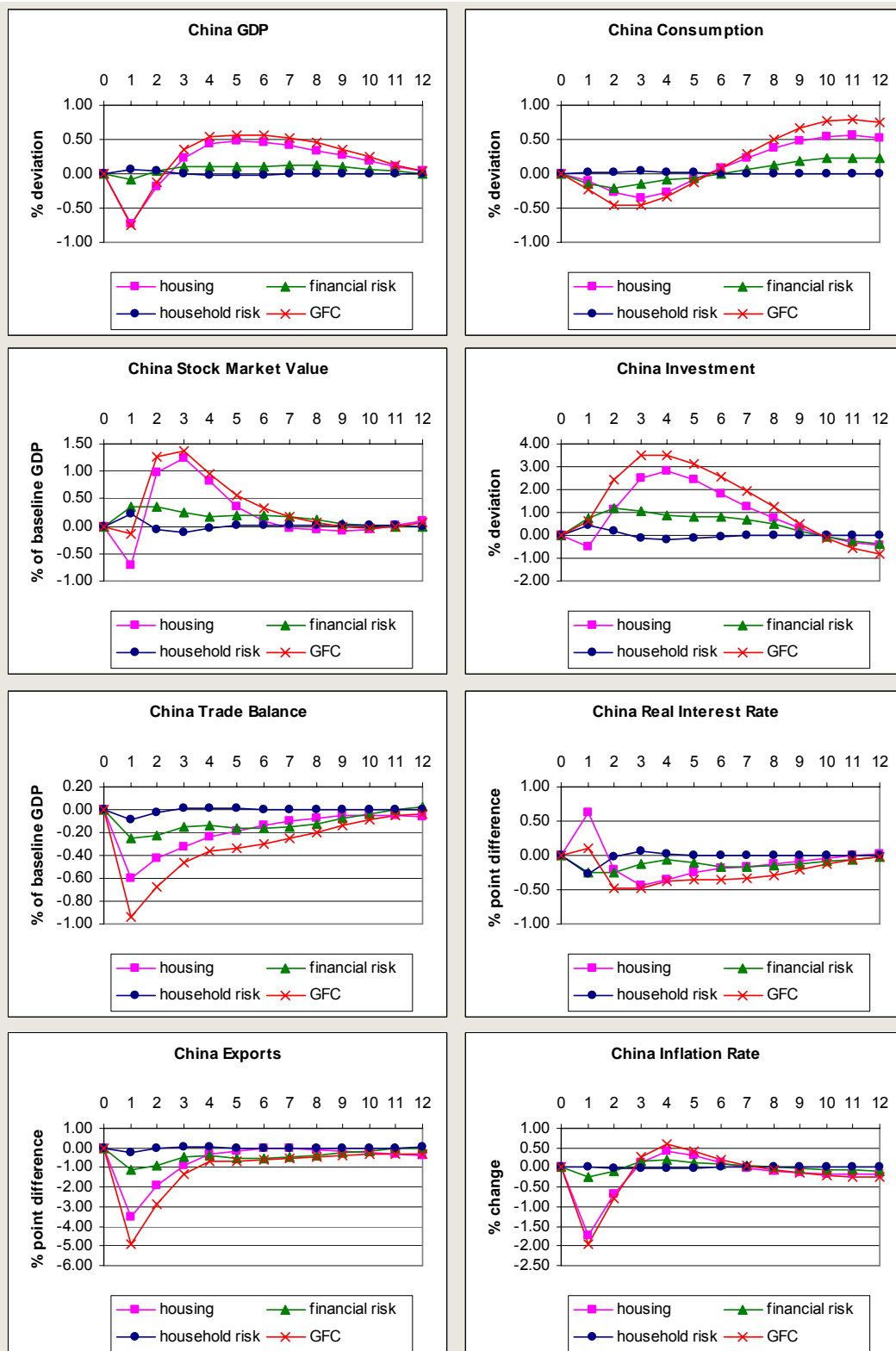*Data source:* G-Cubed model simulations
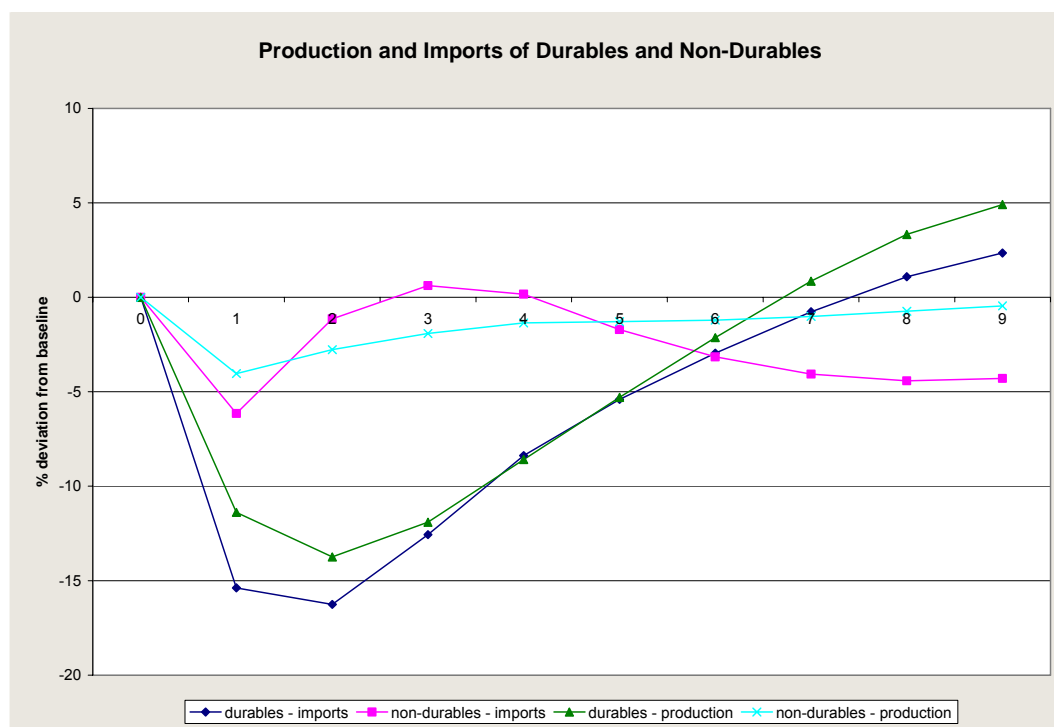
exports of 5 percent below baseline in 2009. China's trade balance worsens, but note how small the effect is: barely 1 percent below baseline (as a percent of GDP).

Note also the net small effect on China's real GDP even though China's exports are a large proportion of their GDP. When the United States alone is affected by the crisis, there is a small combined effect on China of a reduction in real GDP of 0.75 percent below baseline in 2009 and a positive effect from 2011 onwards. Looking at China's real investment provides the answer. Because investment prospects in the United States are now dire under the combined scenario, money flows elsewhere, one recipient of which is China. China's real investment could be 3.5 percent above baseline in 2011 and 2012, in response to the relatively better investment prospects. China gains at the United States' expense. The favourable stimulus from extra investment largely offsets and eventually outweighs the negative effects from the loss of exports to the United States.

The conclusion is that the financial crisis which started in the United States, had it been confined to the US alone, would not have had dire consequences for the world economy. Of course the real story is different. Contagion and rising risk premiums everywhere have caused a different scenario. When everyone is affected the consequences for the United States also depends on who and how other countries are affected.

4.3 **Impact of a US only financial crisis on China**

China GDP

China Consumption

China Stock Market Value

China Investment

China Trade Balance

China Real Interest Rate

China Exports

China Inflation Rate

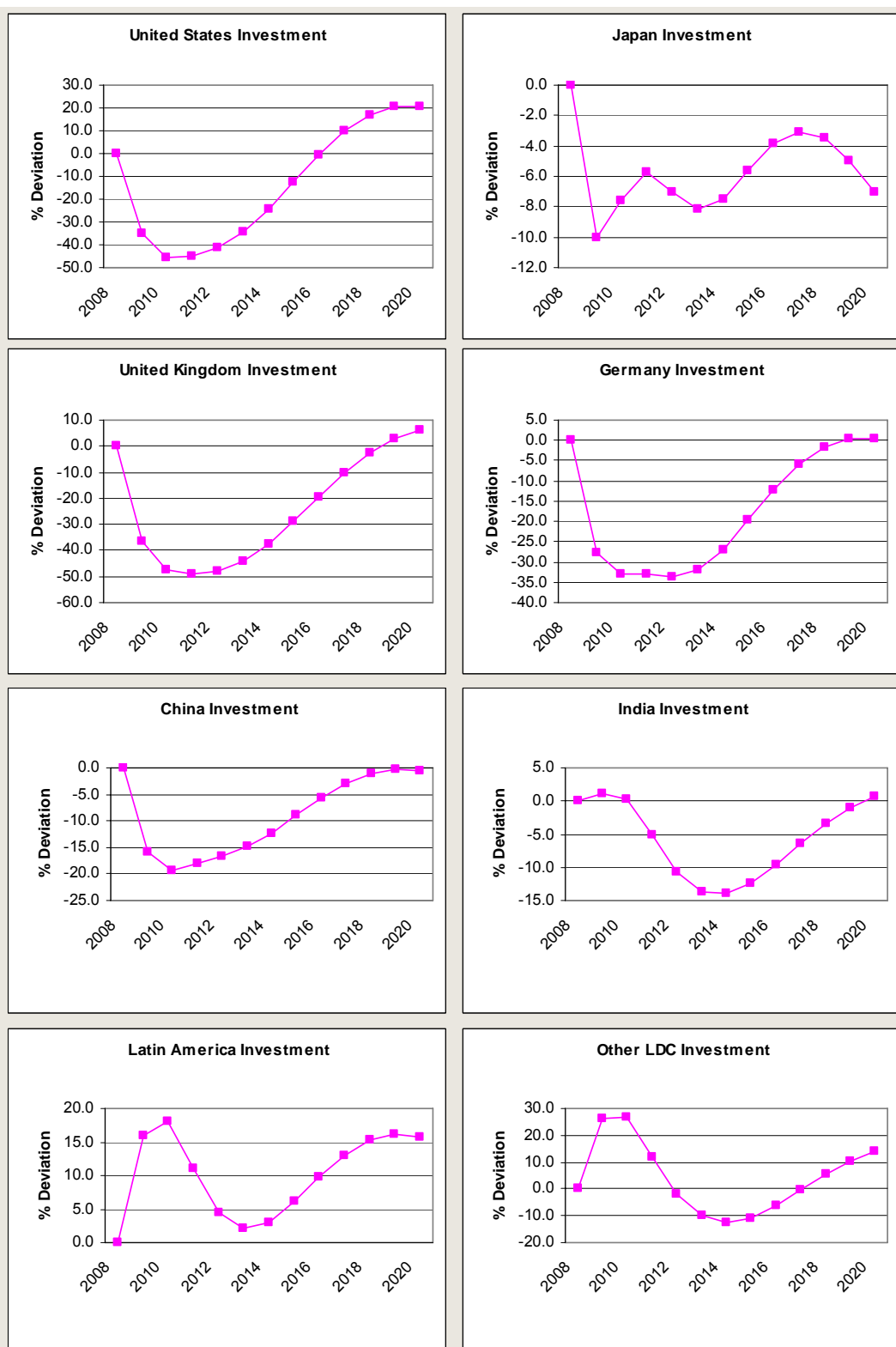*Data source:* G-Cubed model simulations

Projected outlook from the global financial crisis without fiscal stimulus

When all economies are affected by the global financial crisis through global changes in risk premia and loss of consumer confidence, other countries like China are adversely affected. When other economies are also adversely affected by the reappraisal of risk, the cost of capital for them also rises and, in effect, causes the existing capital stock to be too large. Investment plummets, but not everywhere because it is relative effects that matter. The impact on investment is shown in chart set 4.4. Whereas Chinese investment rose when just the United States was assumed to be affected by the crisis, now Chinese investment falls to a low of over 8 percent below baseline in 2010. Real interest rates fall everywhere by over 400 basis points both reflecting a long run decline in marginal product of capital but also reflecting a response of monetary authorities in lowering nominal interest rates.

Under the assumptions of the smaller rise in risk premia across Latin America and LDCs, these regions gain relatively from the global reallocation of investment. Investment in Latin America could be over 15 percent higher over baseline in 2009 and 2010 and well over 20 percent for LDCs for the same years. Latin America and other LDCs do not go into recession (see chart set 4.5) as a result of the global financial crisis as represented by the three shocks used in this study. In fact, those two regions experience a slight boost to real GDP. While some Latin American economies such as Argentina are not faring well at the moment, there are other forces at work such as drought and the impact of taxes on their exports. The results in the appendix graphs do show that exports from Latin America and LDCs to be hit hard, however. They could be 30 percent below baseline in both 2009 and 2010.
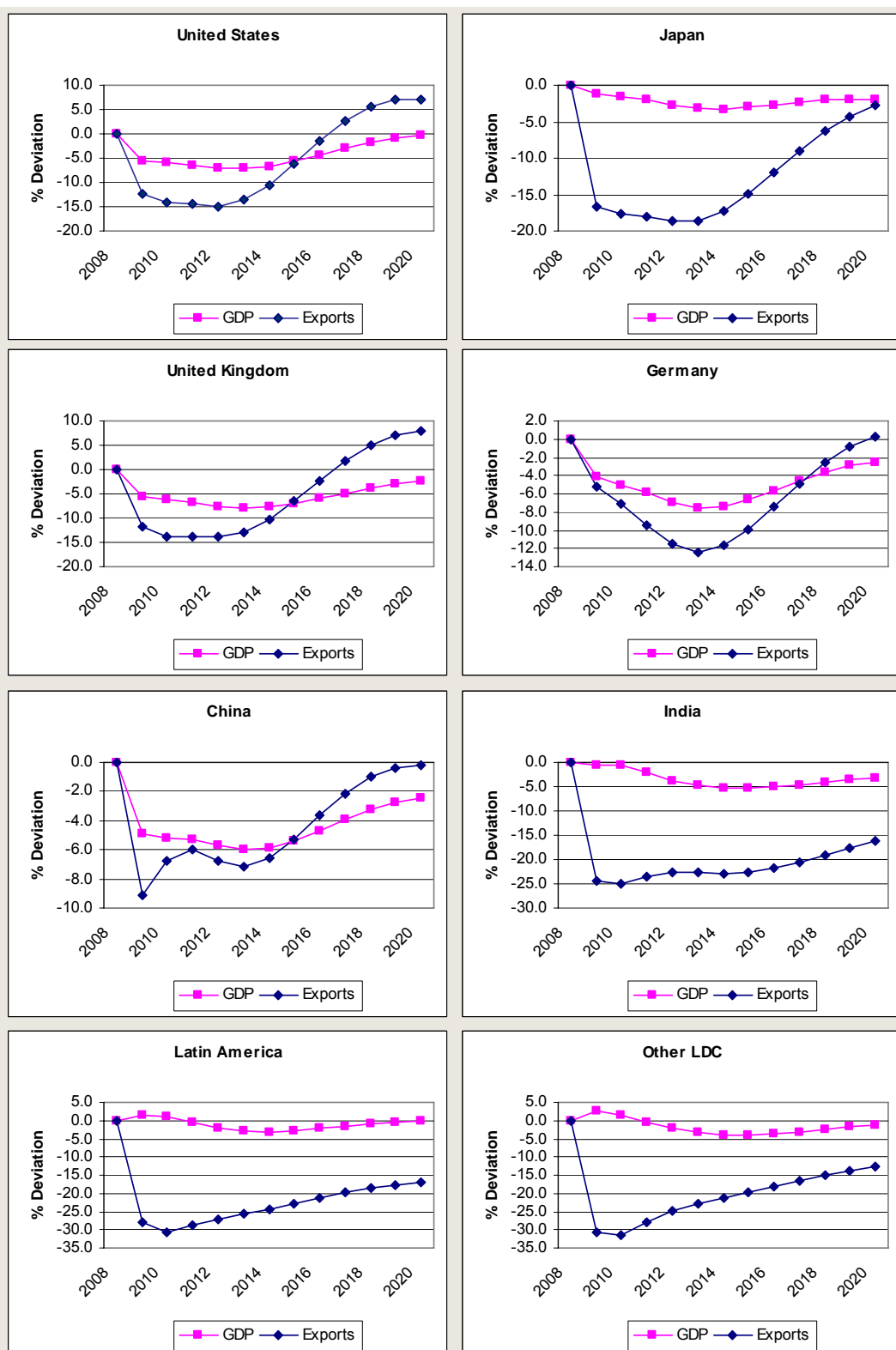
One of the key features of the crisis in reflected in the results in chart set 4.5. There is a substantially larger contraction in exports relative to the contraction in GDP in all economies. This massive shift in the relationship between trade and GDP is not the result of an assumption about the income elasticity of imports. It reflects some key characteristics of the model. First, imports are modeled on a bilateral basis between countries where imports are partly for final demand by households and government and partly for intermediate inputs across the six sectors. In addition, investment is undertaken by a capital sector that uses domestic and imported goods from domestic production and imported sources. As consumption and investment collapse more than GDP, imports will contract more than GDP. One country's imports are another country's exports thus exports will contract more than GDP unless there is a change in the trade position of a particular country. The assumption that all risk premia rise and the results that all real interest rates falls everywhere implies small changes in trade balances- a finding consistent with actual outcomes.

4.4 **Investment effects of GFC**

United States Investment

Japan Investment

United Kingdom Investment

Germany Investment

China Investment

India Investment

Latin America Investment

Other LDC Investment

Data source: G-Cubed model simulations

4.5 **GDP and trade effects of GFC**

Data source: G-Cubed model simulations

5. Effects of policy responses

The results so far have built in a monetary reaction function in the form of a Henderson-McKibbin-Taylor rule for each economy with the short term nominal interest rate adjusting to a variety of factors in each economy. The rules assumed in the model have generated an endogenous monetary response which is similar to that observed so far. The assumption of an unchanged fiscal deficit is very different from what has been observed. In this section we focus on announced fiscal responses. The esimated fiscal policy changes were given earlier in Table 3.7. Note that we do not have infrastructure spending in the model so that the fiscal responses here are assumed to be spending on goods and services and not government investment in physical capital. Expenditure on infrastructure would likely also stimulate medium to long run supply in the model and therefore change the extent to which there is crowding out over time. However to the extent that even infrastructure spending is a demand stimulus for the first few year before the projects begin to deliver medium run supply responses, the initial results in this study can be used to understand the short run impacts of the packages.

Effects of the fiscal stimulus alone

To see the mechanisms at work, the effects of the fiscal stimulus alone are shown in chart set 5.1. These results should be added to the financial crisis results to get a picture of the financial crisis with fiscal response. In discussing these results we will talk about them relative to baseline which can also be interpreted as relative to what would be seen post crisis.

The fiscal stimulus gives a boost to real GDP above baseline for all major economies and China in 2009, the first year of the fiscal packages. The effects are illustrated by referring to China. China's real GDP could be 1.6 percent above what otherwise would be the case in 2009, but little different from baseline in 2010. Real GDP would be below baseline in 2011 in China as the effects of higher real interest rates kick in. Real interest rates could be over 3 percentage points above baseline in 2009 and 2010 (see appendix charts) offsetting much of the decline in real interest rates from the global financial shock and monetary policy responses. Real private investment is 9 percent below baseline in 2010. Considering the massive 11.4 percent cumulative fiscal stimulus in China, the effect of the fiscal stimulus alone is quite small and transitory.

Note that the fiscal stimulus in the first year raises GDP but for all countries this effect only lasts for a year and is much smaller than many commentators assume. Indeed when added to the results for the full GFC simulation this fiscal stimulus is not sufficient to completely neutralize the impact of the crisis on GDP. The main reason involves the real interest rate implications of the fiscal stimulus as shown in Appendix chart C.6. The global nature of the stimulus implies an increase in real interest rates which partly offset the spike down in the first year of the shocks. Note however that higher real interest rates persist for up to 6 years after the stimulus. This points to some serious problems to be faced by policymakers during the recovery period from 2010 onwards.

The fiscal packages also have significant impacts on global trade. In the model the effect of fiscal policy on trade comes in a number of forms operating both through income and relative price effects. If an economy increased government spending, private consumption tends to rise and short term income increases. However the increased borrowing tends to increase real interest rates, which reduces private investment[21]. These two responses have opposite effects on trade. In particular, durable good consumption falls because of the rise in real interest rates, while non-durable good consumption rises due to the income increase. The effect is that imports of durable goods fall and non-durables rise. In addition the higher real interest rate tends to attract foreign capital, which appreciates the real exchange rate and tends to crowd out exports and stimulates income through relative price changes. A country acting alone has a substantial change in the mix of the components of final demand and the real exchange rate dampening on trade tends to dominate the income effect on trade. If there is a global fiscal stimulus, the real exchange rate (or relative price) effects are muted but still present to the extent that the fiscal packages are not symmetric across countries. However, because all countries are acting, the real interest rate effects are accentuated because the call on global savings is much larger than the outcome of any one country acting alone.

Chart set 5.1 shows an interesting story where exports of the industrial economies tend to fall as a result of the fiscal package. This occurs for several reasons. Firstly, because the OECD economies have relatively larger fiscal packages (apart from China), their real exchange rate will tend to appreciate relative to the non- OECD economies, crowding out exports. Secondly, these economies tend to export more durable goods whose demand is reduced by a rise in global interest rates. This effect was also present in the global financial crisis simulation where the risk adjusted discount rise rose sharply (even though real interest rates fell) and the demand for durable goods collapsed. Global trade (see chart 5.6) does not contract in 2009 but falls for several years as growth slows after the fiscal stimulus. By 2014 world trade is above baseline.

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[21] to the extent that there is a substantial supply response through infrastructure, the need for interest rates to rise for a given constrained capacity would be reduced.

5.1 **GDP and export effects of fiscal response**
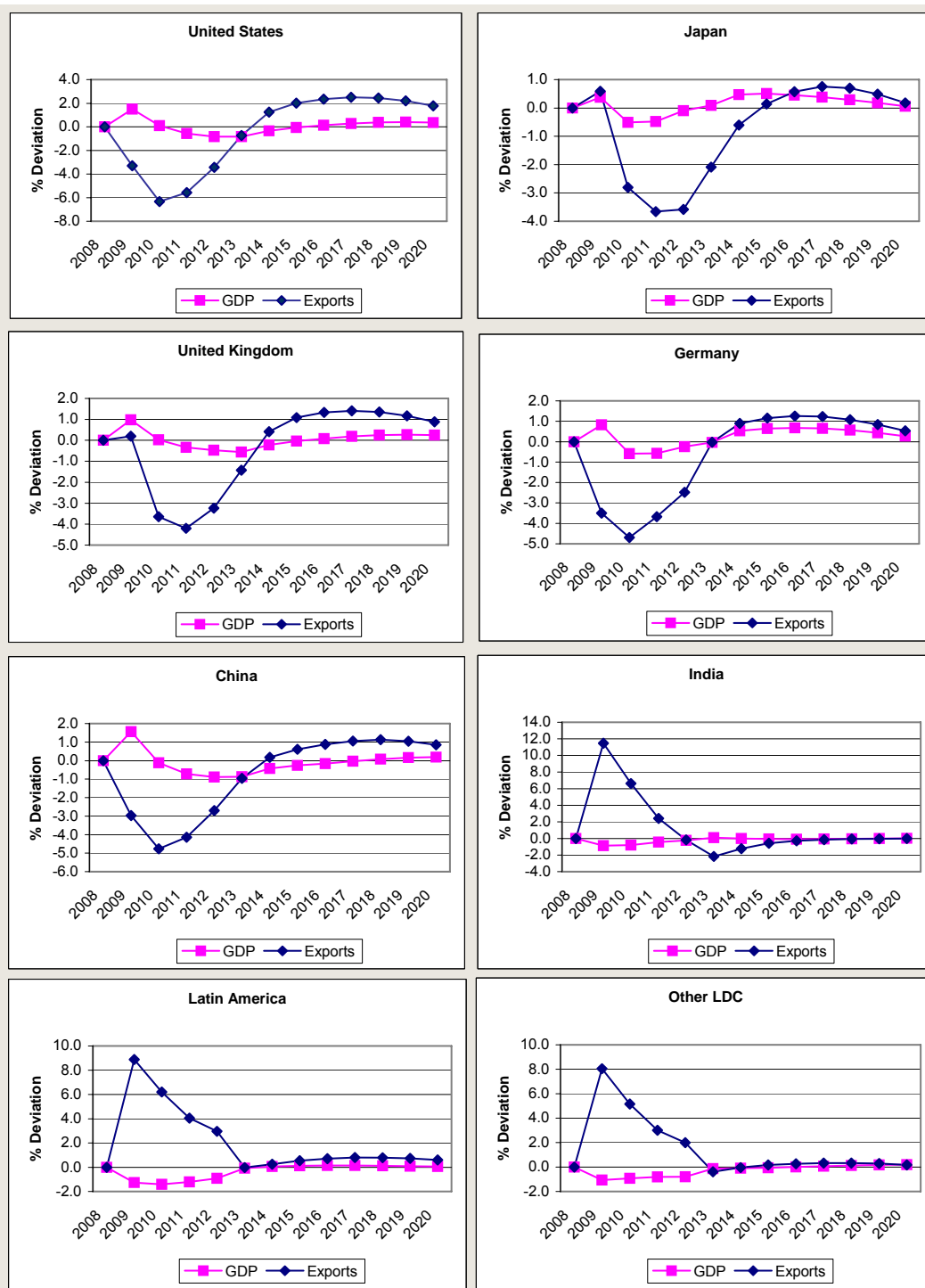
Data source: G-Cubed model simulations

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Trade protectionism

The unfortunate tendency to trade protection was noted earlier. So far there has not been an all-out trade war, possibly due to the hard lessons learned during the Great Depression when such a trade war did break out with disastrous consequences. While industrial economies are in theory able to applied tariff rates up to bound tariffs, as they are legally entitled to do under WTO rules, it is possible to go further by invoking special circumstances and by creating no tariff impediments to trade.
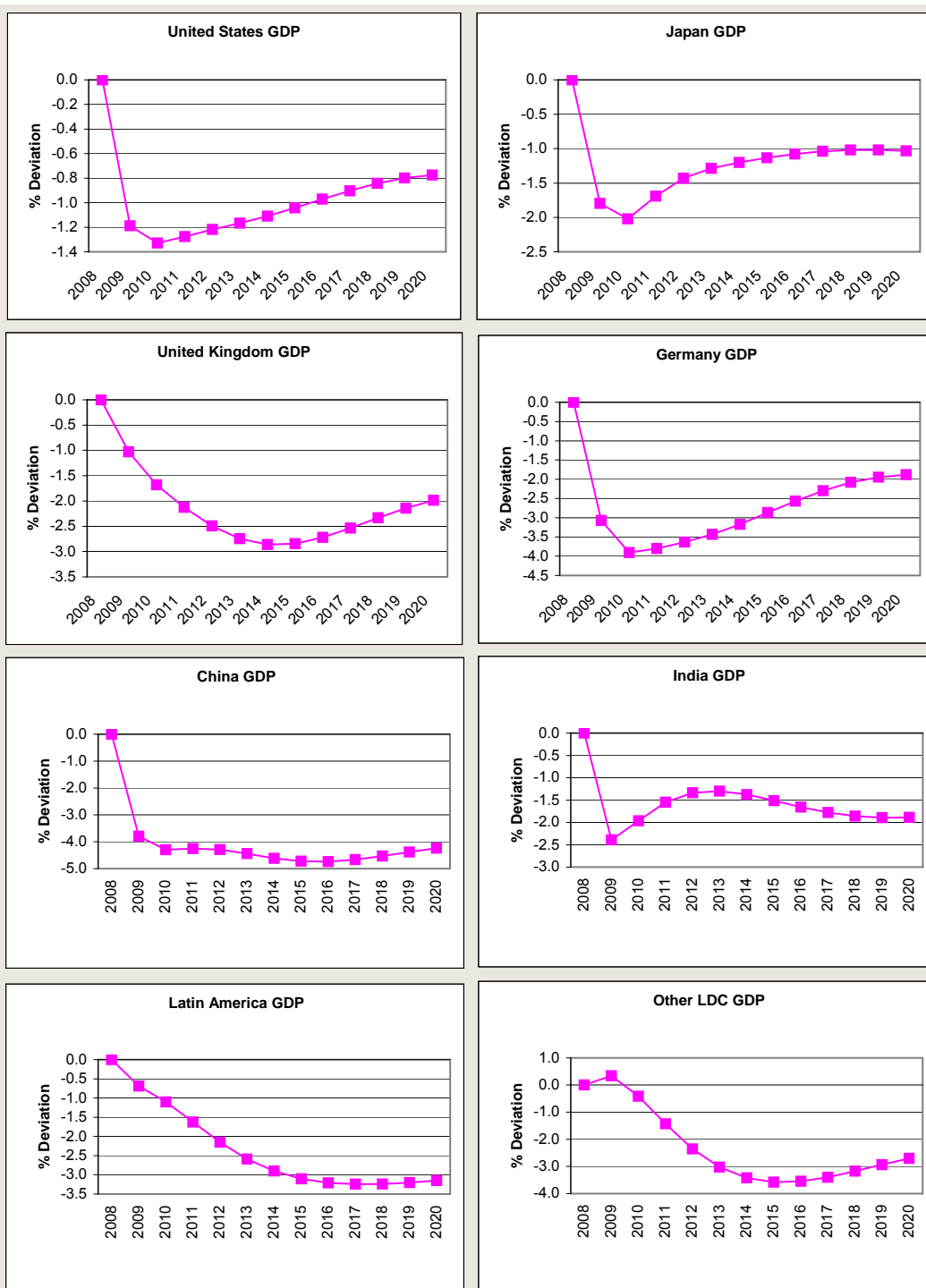
To try and capture a plausible change in protection, the actual shock assumed is a rise in all tariff rates by 10 percentage points (i.e. if a tariff was 5% it becomes 15%). The impacts on real GDP from countries increasing tariff rates are shown in Chart set 5.3. The overall impacts on global trade are shown in Chart 5.5.

The rise in tariffs by 10 percentage points has a significant negative impact on GDP. The decline in real GDP relative to baseline varies in 2009 between 1.4 percent for the United States and United Kingdom to 4.0 percent for Germany. The outcomes reflect the relative openness of the economies and the trade linkages between economies. Overall the effects of a rise in tariffs by 10 percentage points, is to reduce trade by nearly 17% by 2012 (see Chart 5.5).

As tariffs rise, the input costs of industries increase which tends to raise costs and reduce demand in the economy. The rise in relative prices of imports also causes import demand to fall which reduces incomes of the exporting countries. This contraction in global trade and contraction in global incomes is self reinforcing and hence the world economy contracts. There is a reallocation of global capital away from sectors in which tariffs have risen because the return to capital in those sectors is expected to fall because demand for those goods that have become more expensive is expected to fall. There is also a rise in the imported price of capital goods which are traded and therefore the physical amount of capital created from a constant expenditure on investment is less in all economies. This further contracts potential output.

Table 5.4 decomposes the effects of a change in global tariffs into the effects from the change in tariffs from each country or region listed across the columns on each country. Thus in 2011 the tariff scenario reduces US GDP by 1.28 percent below baseline. The impact of the US tariff increase alone on the United States is 0.28 percent in 2011. The US tariff reduces Canadian GDP by 1.76 percent in 2011 which is the major part of the total loss to Canada of 2.2 percent of GDP. Most countries are too small to gain from a rise in tariffs although several regions do initially experience a small rise in GDP from their own tariff increased but a fall in GDP on balance when the whole world raises tariffs. For all countries the effect of a tariff increase is to reduce its own GDP. The favourable demand side impact of diverting demand from imports to domestic goods is outweighed by the increase in costs of production.

5.3 **GDP effects of tariff rise**

United States GDP

Japan GDP

United Kingdom GDP

Germany GDP

China GDP

India GDP

Latin America GDP

Other LDC GDP

Data source: G-Cubed model simulations

5.4: **GDP consequences of Tariff Changes by 2011** – percent deviation from baseline

|	Global	USA	Japan	Europe [1]	OOECD[2]	China	India	EEFSU	ODCs[3]
				Source of Tariff Change					
United States	-1.28	-0.28	-0.05	-0.25	-0.33	-0.04	-0.01	0.01	-0.33
Japan	-1.69	-0.36	-0.65	-0.15	-0.02	-0.12	0.00	0.02	-0.41
United Kingdom	-2.12	-0.25	-0.02	-1.48	-0.18	-0.02	-0.01	-0.06	-0.09
Germany	-3.80	-0.33	-0.04	-2.64	-0.26	-0.04	-0.01	-0.39	-0.08
Euro Area	-2.93	-0.30	-0.05	-1.84	-0.18	-0.03	-0.01	-0.24	-0.26
Canada	-2.20	-1.76	-0.04	-0.27	-0.21	-0.02	-0.01	0.02	0.08
Australia	-1.36	-0.34	-0.15	-0.32	-0.17	-0.09	-0.02	0.03	-0.30
ROECD	-3.74	-0.37	-0.06	-1.74	-1.21	-0.03	-0.01	-0.19	-0.11
China	-4.26	-0.93	-0.29	-0.29	0.05	-1.12	-0.01	-0.09	-1.58
India	-1.55	-0.20	-0.03	-0.22	0.01	-0.03	-0.61	0.01	-0.47
Other Asia	-3.86	-0.98	-0.18	-0.32	-0.03	-0.42	-0.02	-0.02	-1.88
Latin America	-1.63	-1.32	-0.03	-0.26	0.12	-0.03	-0.01	-0.04	-0.06
Other LDC	-1.43	-0.54	-0.02	-0.60	0.05	-0.04	-0.04	-0.15	-0.09
EEFSU	-3.54	-0.61	-0.05	-2.02	-0.08	-0.07	-0.01	-0.62	-0.08
OPEC	-4.45	-0.90	-0.37	-1.00	-0.20	-0.16	-0.06	-0.12	-1.63

Notes: Source G-Cubed Model;

1. Europe is UK, Germany & Euro Area;

2.OOECD is Canada, Australia and ROECD;

3. ODCs is Other Asia, Latin America, Other LDC and OPEC

5.5 **Impact of the GFC, Fiscal Response and Trade War on Global Trade**

Change in World Trade under 3 scenarios

Data source: G-Cubed model simulations
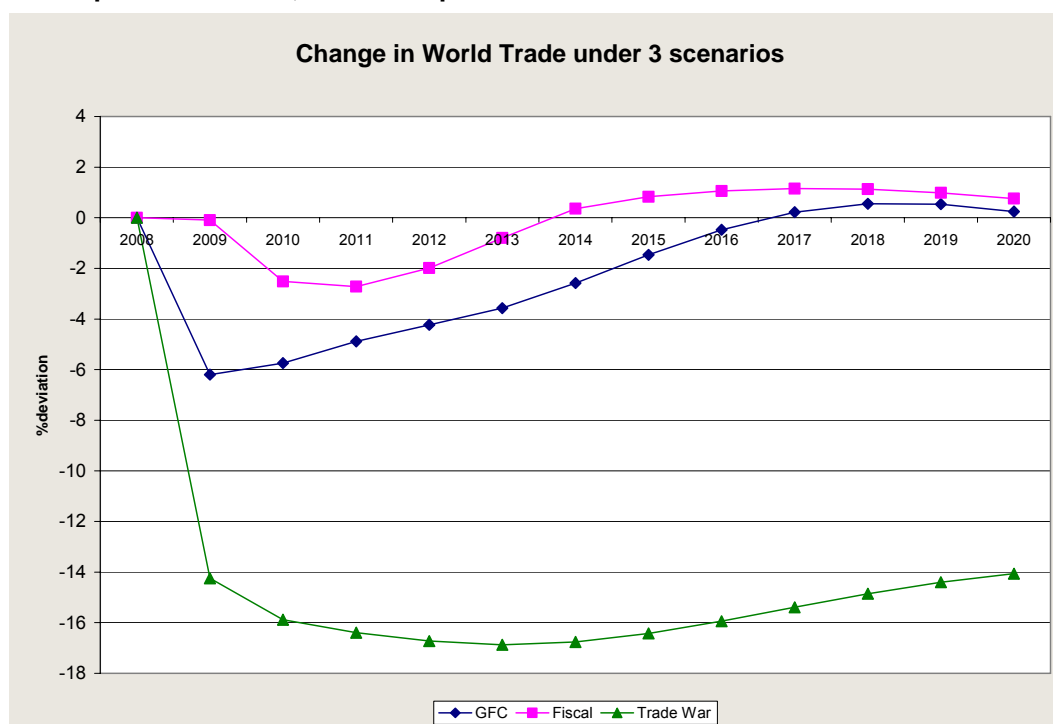
6. Insights gained

To represent the effects of the financial crisis on the world economy and trade flows, six elements are needed. For the crisis itself three shocks are needed to capture the observed drop in asset prices and reduction in demand and trade. It is necessary to simulate the bursting of the housing bubble centred in the United States and Europe, but extending elsewhere, rising perceptions of risk by business as reflected in the equity risk premium over bonds and rising perceptions of risk by households.

The policy response has been dramatic. So the analysis has included a monetary easing across the globe and a fiscal stimulus of varying proportions across countries and regions. Also, some trade protectionism has emerged, so far in terms of some tariff increases, some support for industry, such as automobile manufacturers and other effects such as "Buy Local" programs and directives. So a third policy response has been included in the analysis, namely a rise in protectionism. There has also been a rise in financial protectionism, such as directives to banks to lend locally, but absent any estimate of how big this effect is, has not been formally included in this analysis. But financial protection affects capital flows and so would affect trade flows.

Simulating the effect of the crisis itself (that is ignoring the policy responses not already built into the model such as endogenous monetary policy rule) on the United States alone (the 'epicentre'

of the crisis) shows several things. Had there not been the contagion across other countries in terms of risk reappraisal, the effects would not have been as dramatic. The adverse trade effects from the United States downturn would have been offset to some degree by positive effects from a global reallocation of capital. Were the US alone affected by the crisis, Chinese investment could have actually risen. The world could have escaped recession. When there is a reappraisal of risk everywhere including China, investment falls sharply – in a sense there is nowhere for the capital to go in a global crisis of confidence. The implication is that if markets, forecasters and policy makers misunderstand the effects of the crisis and mechanisms at work, they can inadvertently fuel fears of a 'meltdown' and make matters far worse.

When there is a global reappraisal of risk there is a large contraction in output and trade. The bursting of the housing bubble has a bigger effect on falling consumption and imports than does the reappraisal of risk, but the reappraisal of risk has the biggest effect on investment. Rising risk causes several effects. The cost of capital is now higher and leads to a contraction in the desired capital stock. Hence there is disinvestment by business and this can go on for several years – a deleveraging in the popular business media. The higher perception of risk by households causes them to discount future labor incomes and leads to higher savings and less consumption, fuelling the disinvestment process by business.

The fiscal policy response initially has the desired effect of increasing domestic demand and hence real GDP. While the boost to domestic demand on its own boosts trade there are other effects going on that have an adverse effect on trade. The fiscal stimulus and accompanying borrowing, causes real interest rates to rise over what they would otherwise be. This effect would be diluted if the global economy remained in recession for a long period. However, the natural recovery from the shocks as shown in the results implies that there will be competition by government and the private sector over scarce funds for either private investment or to finance fiscal deficits. The rise in real interest rates (relative to what they would have been) and fall in investment and durable good demand implies that exports fall and do not get back to baseline for several years. For the United States this is takes until 2013 and exports are 6 percent below baseline in 2010. The fiscal stimulus does not apparently help trade largely because of the impact of higher real interest rates on durable goods demand and investment.

So far, cases of rising trade protection have been sporadic as mostly governments have resisted protection to bow to political pressure and protect narrow vested interests. Policy makers are right to be worried about trade protection as a resort to widespread protection would make matters much worse. For example, if countries raises tariffs by 10 percentage points, additional falls of real GDP of between 1 and 4.5 percent below baseline could occur and exports could variously fall by between 5 and 20 percent below baseline for major economies. One of the conclusions of this study is that the crisis and trade protection, all work to discourage exports. The asymmetric fiscal expansions redistribute global trade initially with a small impact overall but have a medium term negative impact on world trade after the first year as the aftermath of the fiscal responses crowd out global demand and slow the recovery.

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Appendixes

A. Sectoral growth rates underlying the baseline

Following the approach in McKibbin, Pearce and Stegman (2007), the energy sector in the US is assumed to have a rate of productivity growth of 0.1 percent over the next century. Each non-energy sector has an initial productivity growth rate close to historical experience but gradually converging to 1.8 percent per year in the long run. We then assume that each equivalent sector in each other country will catch up to the US sector in terms of productivity, closing the gap by 2 percent per year except for the developing country region which is assumed to close the gap by 1 percent per year. The initial gaps are therefore critical for the subsequent sectoral productivity growth rate. We follow a two step process in determining the initial size of the gap. The first step is to specify the gap between all sectors and the US sectors equal to the gap between aggregate PPP GDP per capita between each country and the US. We cannot easily use sectoral PPP gap measures because these are difficult to get in a consistent manner and with a wide enough coverage for our purposes. Thus the initial benchmark is based on the same gap for each sector as the initial gap for the economy as a whole. If we then have evidence that a particular sector is likely to be closer to or further away from the US sectors than the aggregate numbers suggest, we adjust the initial sectoral gaps attempting to keep the aggregate gaps consistent with the GDP per capita gaps. We then assume that productivity growth in each sector closes the gap between that sector and the equivalent US sector by 2 percent per year. The productivity growth is calculated exogenously to the model. We then overlay this productivity growth model with exogenous assumptions about population growth for each country to generate two of the main sources of economic growth.

Given these exogenous inputs for sectoral productivity growth and population growth, we then solve the model with the other drivers of growth, capital accumulation, sectoral demand for other inputs of energy and materials, all endogenously determined. Critical to the nature and scale of growth across countries are these assumptions plus the underlying assumptions that financial capital flows to where the return is highest, physical capital is sector specific in the short run, labor can flow freely across sectors within a country but not between countries and that international trade in goods and financial capital is possible subject to existing tax structures and trade restrictions.

Thus the economic growth of any particular country is not completely determined by the exogenous inputs in that country since all countries are linked through goods and asset markets.

In the analysis in this paper we start with a projection of the model from 2007 assuming no shocks to relative prices apart from those built into the productivity projections. We then imposed each shock on this baseline to generate results as deviation from the baseline. While the emergence of major developing countries is already partly built into the baseline, we focus on the marginal changes as specified in the scenarios described in the body text.

Appendx B. Classification of fiscal measures for 2009–10[a]

	Fiscal package[b]	Rescue package as a percentage of GDP	I. Public spending on goods and services	II. Fiscal stimulus aimed at customers	III. Fiscal stimulus aimed at firms
	US$b	%			
Australia[c]	22.0	1.8	Funding for schools and hospitals; transportation projects (railway and highway)	Help to 4 million pensioners, carers and seniors; carer allowance; support for low and middle incme families; help to first time home buyers -- total spending in this category adds up to approximately $10 billion.	Supporting car manufacturers; investment allowance
Brazil	3.6	0.2		Extension of Bolsa (CCT program) to include 5 million more citizens; increase in minimum wage by 12% as of 1 February; tax cuts on consumer loans and personal income to boost car sales	Tax cuts to help auto manufacturers
China	586.0	6.9	Speeding up rural infrastructure construction; accelerating the expansion of railways; airport construction in Western province; upgrading power grids; greater spending on health and education in rural areas; enhancing the construction of sewage and waste treatment facilities (total spending in this category is approximately 3 trillion RMB)	Low rent housing (0.28 trillion RMB); raising minimum grain purchases and farm subsidies; subsidies for low income urban residents; increasing the number of pension funds	Direct tax cuts for nine industries (steel, telecommunications, automotive, etc.); support and development of high-tech and service industries; remove loan quotas on commercial lenders

B.2 **Classification of fiscal measures^a** (Continued)

	Fiscal package^b	Rescue package as a percentage of GDP	I. Public spending on goods and services	II. Fiscal stimulus aimed at customers	III. Fiscal stimulus aimed at firms
	US$b	%			
France	33.0	1.3	Increasing investments in infrastructure projects	€200 payment for 3.8 million impoverished households	Protection for the auto sector; support for business; investing in housing and construction; social tax exemption for employers (with less than ten workers) who have new employees in 2009
Germany^d	103.3	1.6	Infrastructure investment (schools and roads) worth €18 billion	Income tax cuts (€9 billion); reduction in health insurance contributions (€9 billion taking into account employers as well); €2,500 payment for drivers who buy a low emission car; €100 cheques per child	Reduction in health insurance contributions
Italy	6.3	0.3	Stepped up public works spending	€2.4 billion cash payments to low income families; mortgage relief; additional welfare spending	Corporate tax breaks
Japan	110.0	2.3	Funds to local governments to invest in infrastructure projects; accelerated introduction of energy saving technologies; tax incentives for energy saving technologies	Aid to unemployed workers; housing assistance; UE insurance extension; cash transfers regardless of income	Increased wage subsidies for SME employers; subsidise employers who hire temporary workers as regular employees; inject funds into domestic banks to support small and medium sized businesses
Russia	20.0	1.1		Tax cuts	Tax cuts

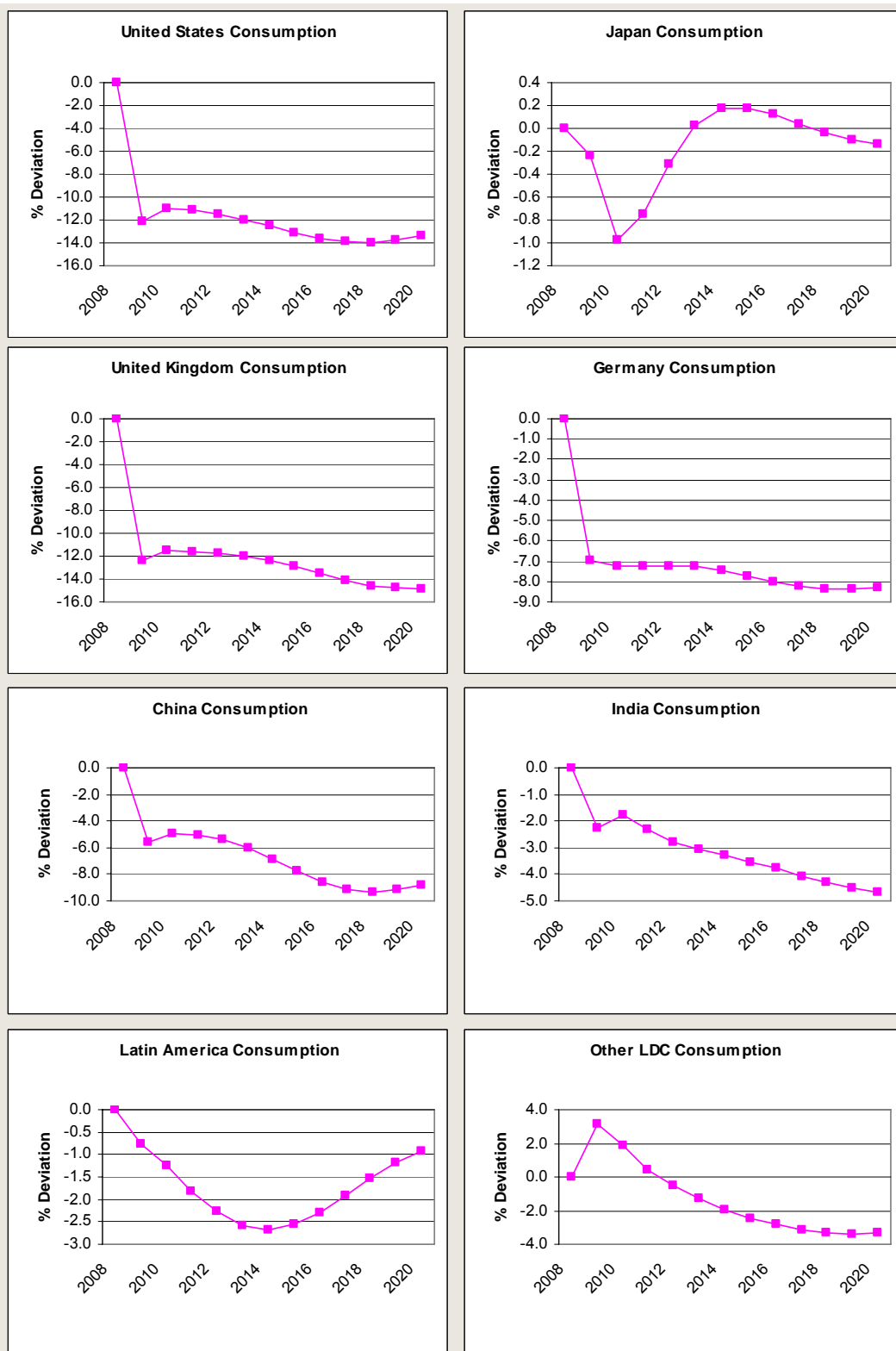B.2 **Classification of fiscal measures**[a]   (Continued)

	Fiscal package[b]	Rescue package as a percentage of GDP	I. Public spending on goods and services	II. Fiscal stimulus aimed at customers	III. Fiscal stimulus aimed at firms
	US$b	%			
Spain	113.4	8.1	New public work projects; creation of Fund for Local Entities and the Special Fund for Employment and Economic Reactivation	Tax support measures for families; increase in social welfare; delay in mortgage payments for families with unemployed breadwinners	Tax cuts; increased access to credit for SMEs
United Kingdom	36.4	0.9	Infrastructure spending (£3 million)	VAT reduction from 17.5 to 15 percent (£12.5 billion); permanent increase in personal income tax allowance for basic rate taxpayers (£3.19 billion)	Subsidies for employers (up to £2,500) who hire workers that have been unemployed for more than six months; other employment measures (£1.3 billion)
United States	787.0	5.5	Infrastructure spending; production of energy from renewable resources; aid to science facilities and research; broadband service in rural areas; aid to school districts and public colleges; additional aid to schools serving low income areas; increase in the side of Pell grants (education grants)	Tax relief for low wage and middle income workers of roughly US$300 billion; extended jobless benefits and retraining; health coverage for the unemployed; temporary increase in food stamps	Help to car makers and other distressed sectors in need of credit
Rest of world	149.2				
Total	**1958.2**				
World GDP in 2008	62 054.1				
Total fiscal package as a percentage of world GDP		3.16			

[a] Announced measures by each country. The time period of spending is not clear for most countries. [b] GDP in 2008, IMF. [c] Australia works on a fiscal year basis 2009-10. [d] The timeframe is two years, hence the package was divided by two.
Source: ILS, based on Bloomberg, CNBC and national newspapers.

C. Detailed results

C.1 **Consumption effects of GFC**

Data source: G-Cubed model simulations

C.2 **Trade balance effects of GFC**

United States Trade Balance

Japan Trade Balance

United Kingdom Trade Balance

Germany Trade Balance

China Trade Balance

India Trade Balance

Latin America Trade Balance

Other LDC Trade Balance
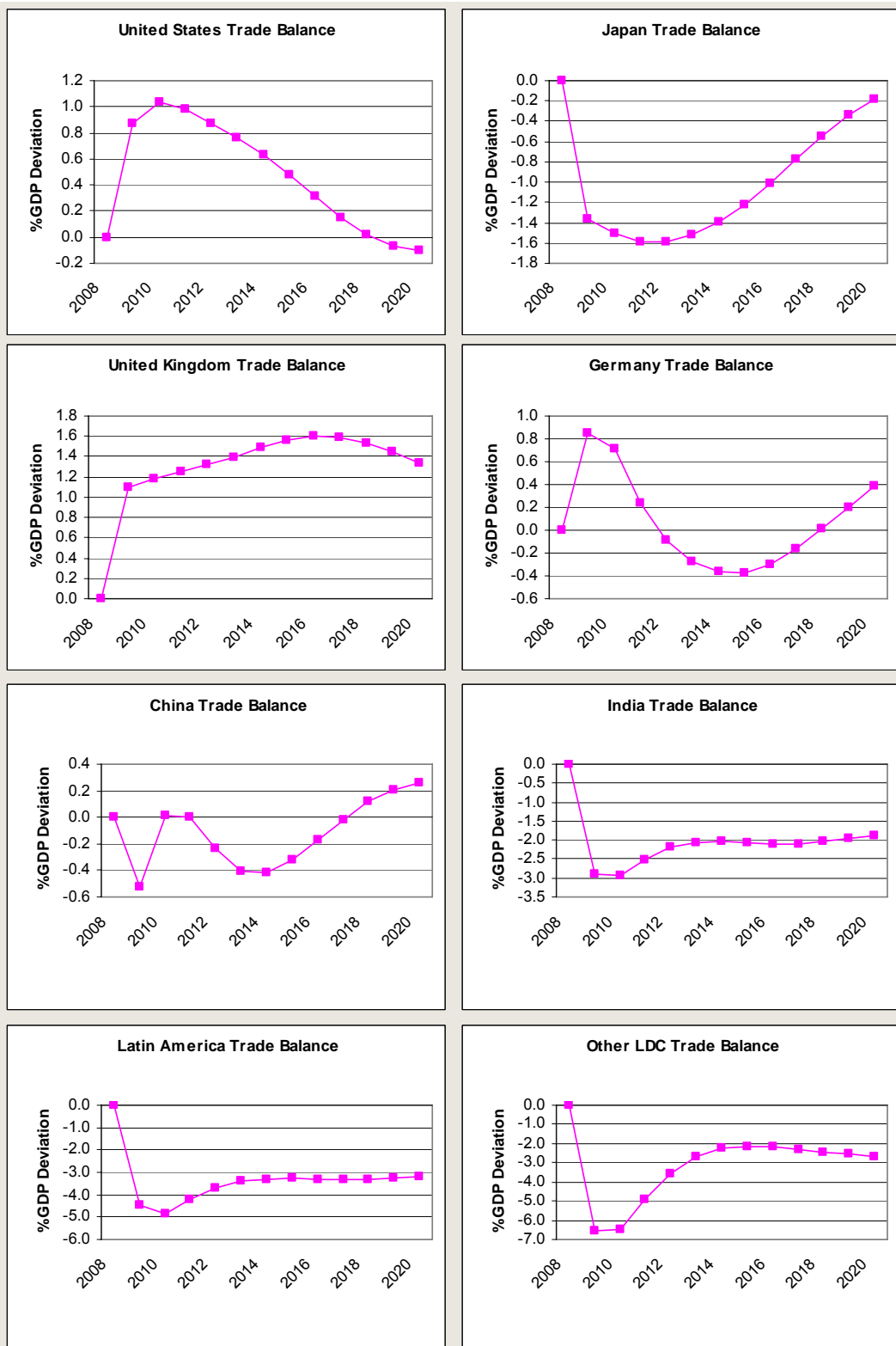
Data source: G-Cubed model simulations

C.3 **Real interest rate effects of GFC**

United States Real Interest Rate

Japan Real Interest Rate

United Kingdom Real Interest Rate

Germany Real Interest Rate

China Real Interest Rate

India Real Interest Rate

Latin America Real Interest Rate

Other LDC Real Interest Rate

Data source: G-Cubed model simulations

C.4 **Real effective exchange rate effects of GFC**

United States Real Effective Exchange Rate

Japan Real Effective Exchange Rate

United Kingdom Real Effective Exchange Rate

Germany Real Effective Exchange Rate

China Real Effective Exchange Rate

India Real Effective Exchange Rate

Latin America Real Effective Exchange Rate

Other LDC Real Effective Exchange Rate
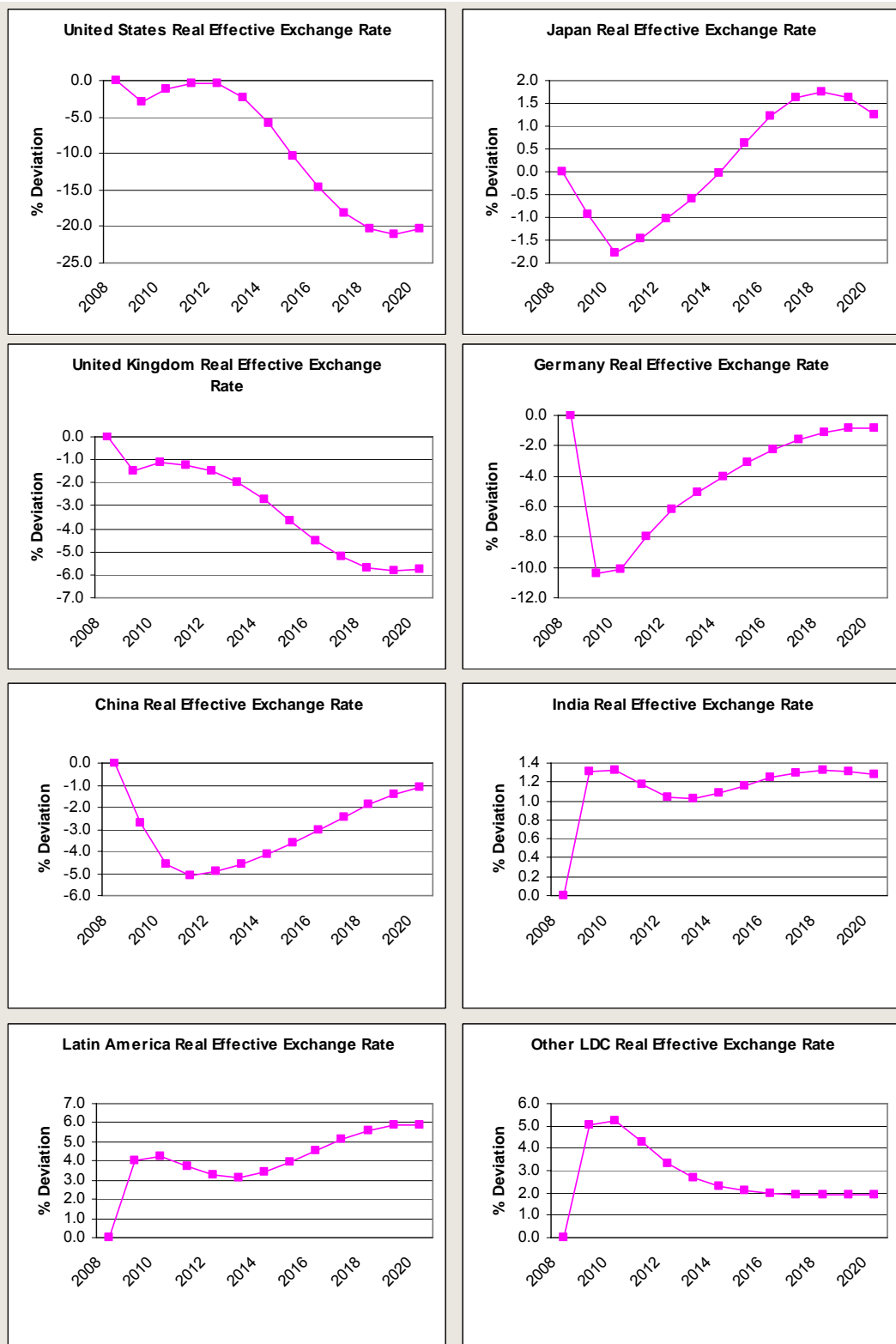
Data source: G-Cubed model simulations

C.5 **Investment effects of fiscal response**
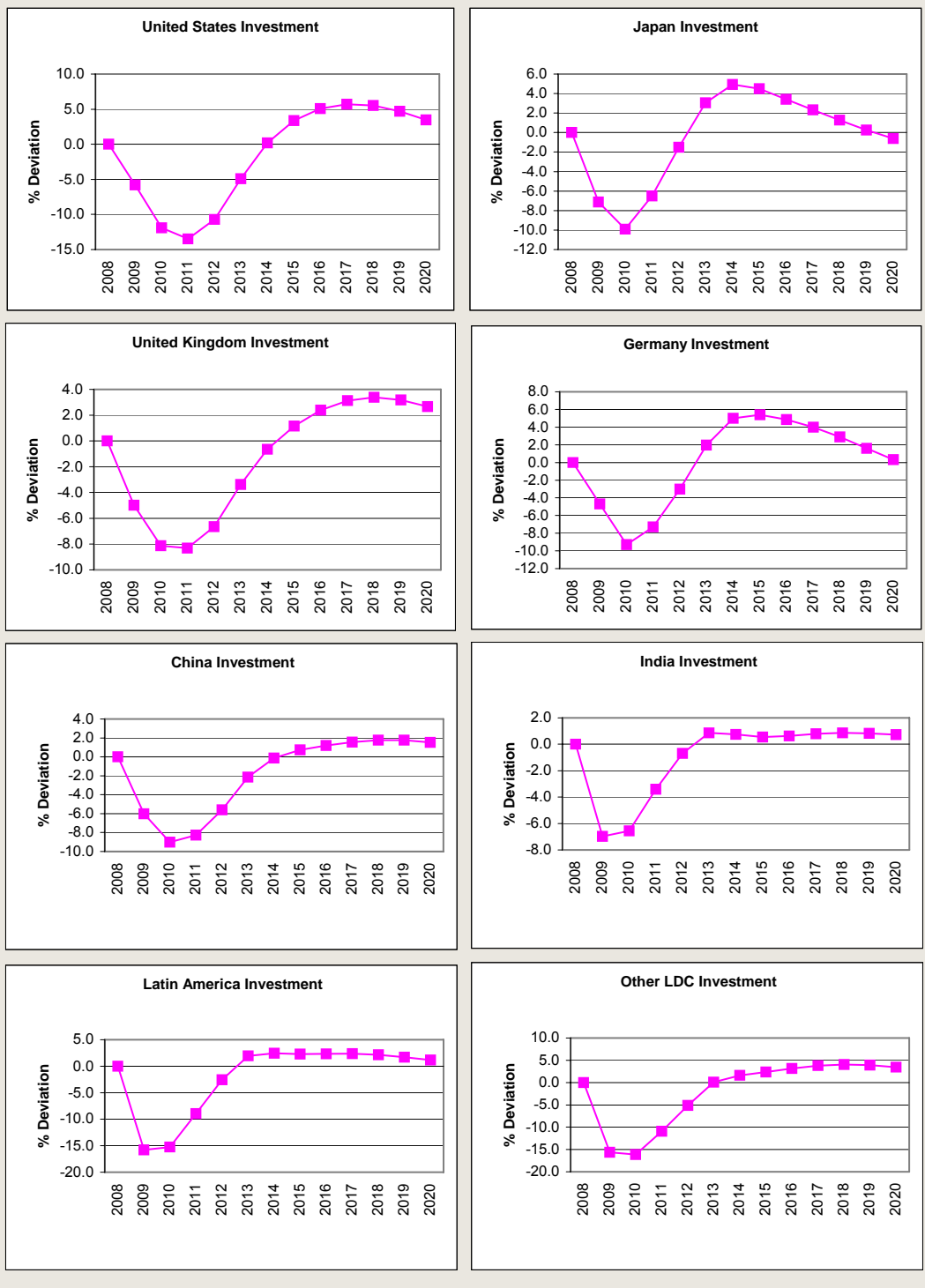
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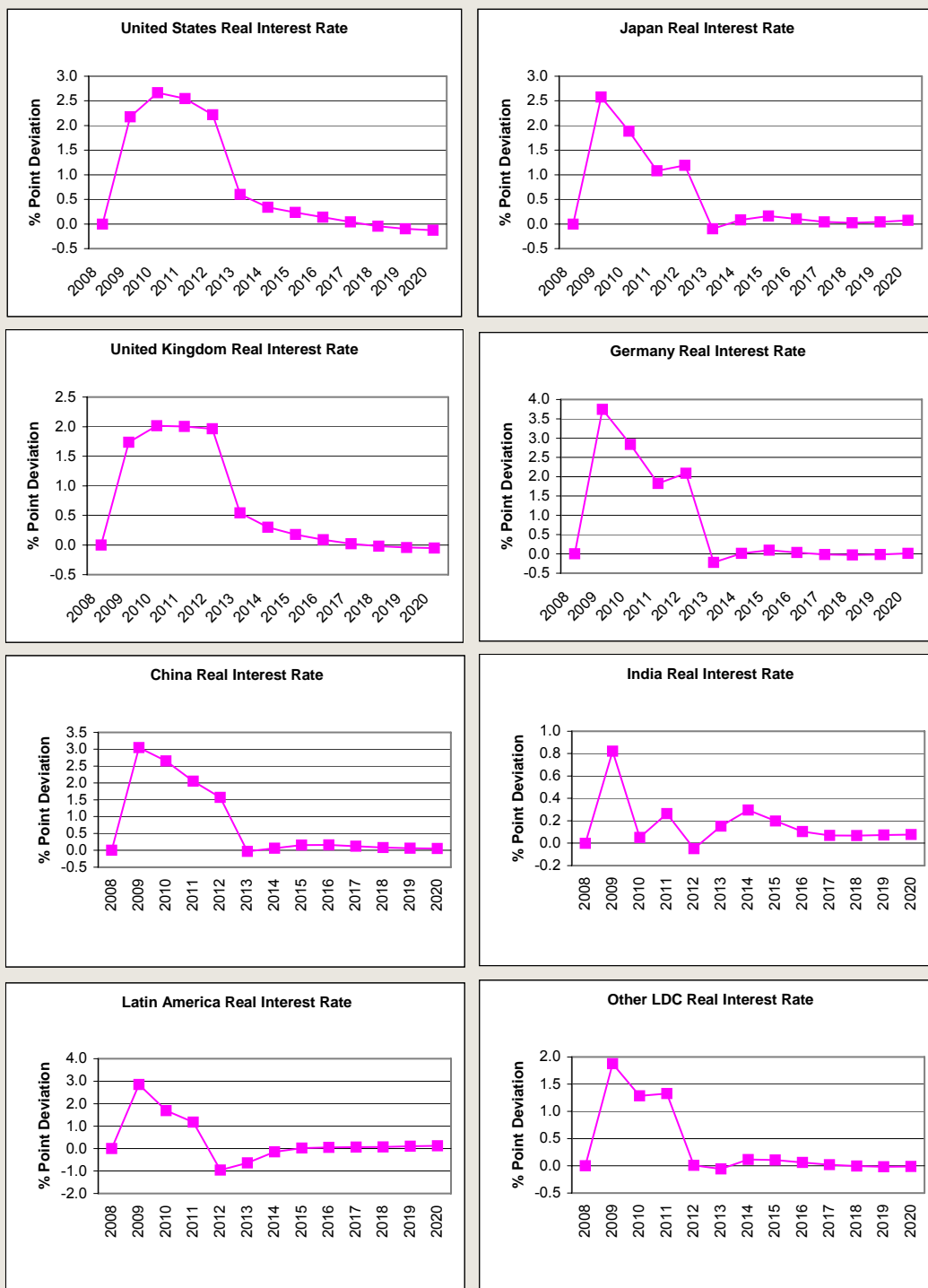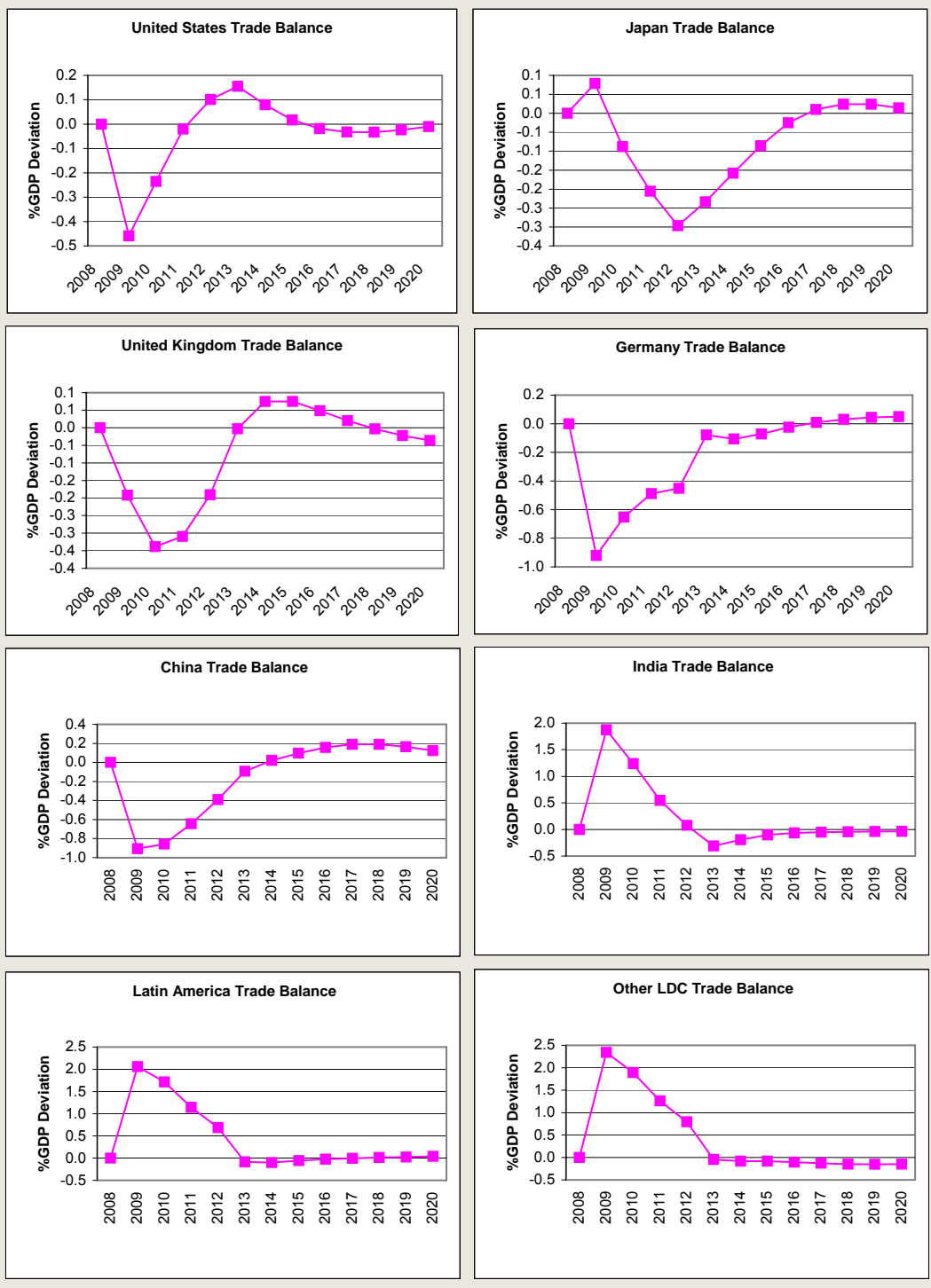
C.6 **Real interest rate effects of fiscal response**

Data source: G-Cubed model simulations

C.7 **Trade balance effects of fiscal response**

United States Trade Balance

Japan Trade Balance

United Kingdom Trade Balance

Germany Trade Balance

China Trade Balance

India Trade Balance

Latin America Trade Balance

Other LDC Trade Balance

Data source: G-Cubed model simulations

C.8 **Real effective exchange rate effects of fiscal response**

Data source: G-Cubed model simulations

C.9 **Trade effects of tariff rise**

Data source: G-Cubed model simulations

C.10 **Trade balance effects of tariff rise**
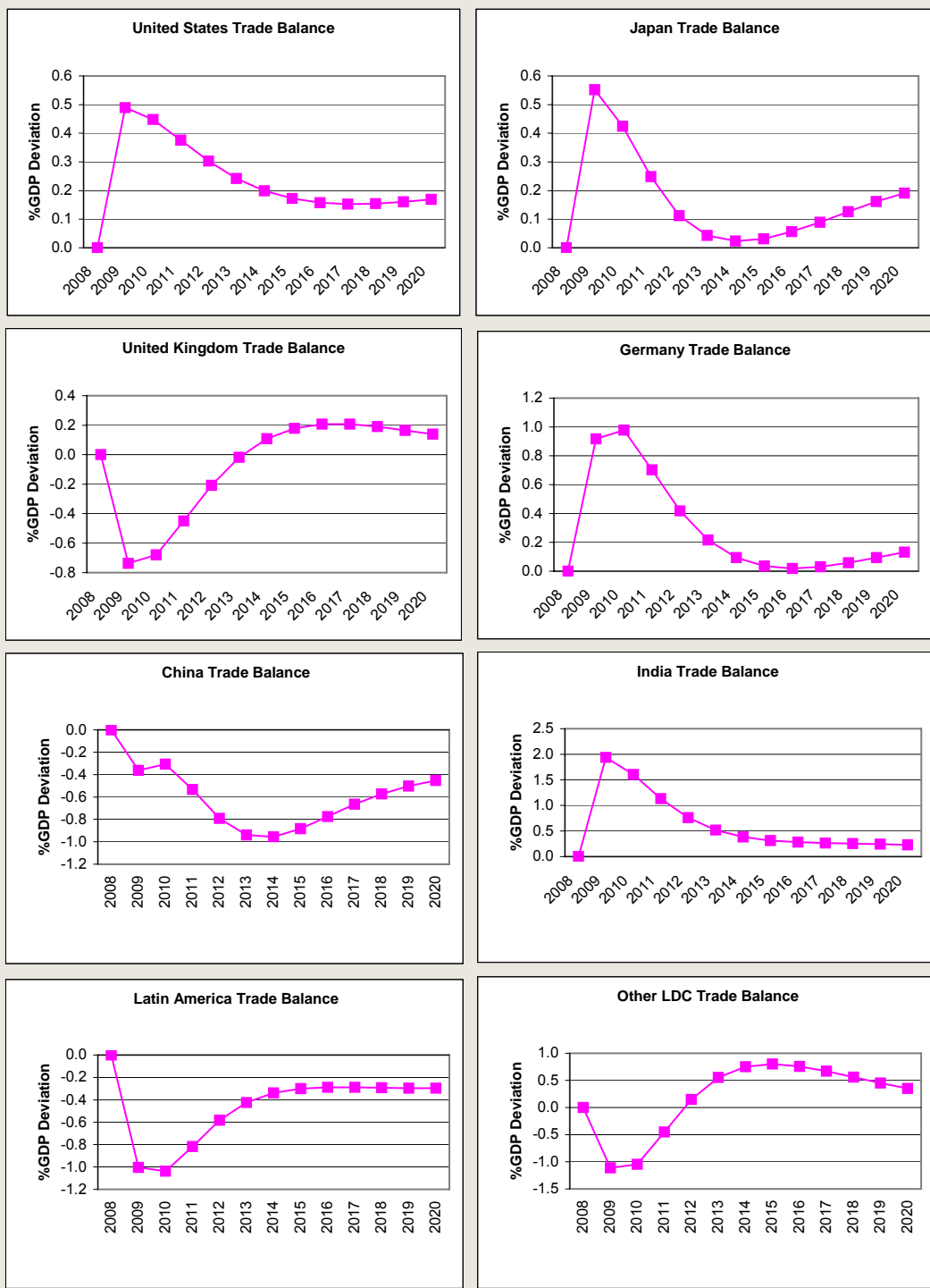
Data source: G-Cubed model simulations

C.11 **Investment effects of tariff rise**

Data source: G-Cubed model simulations
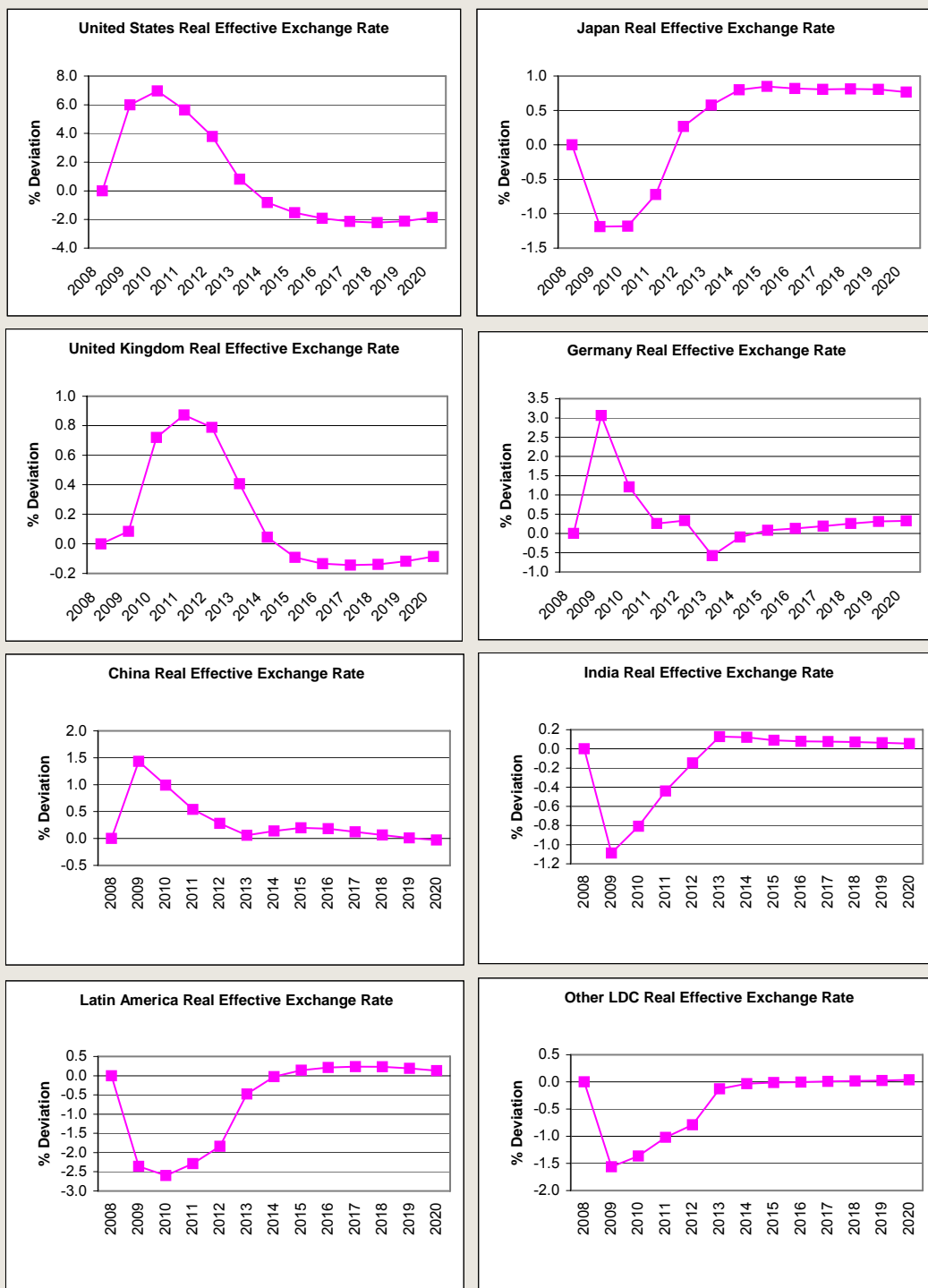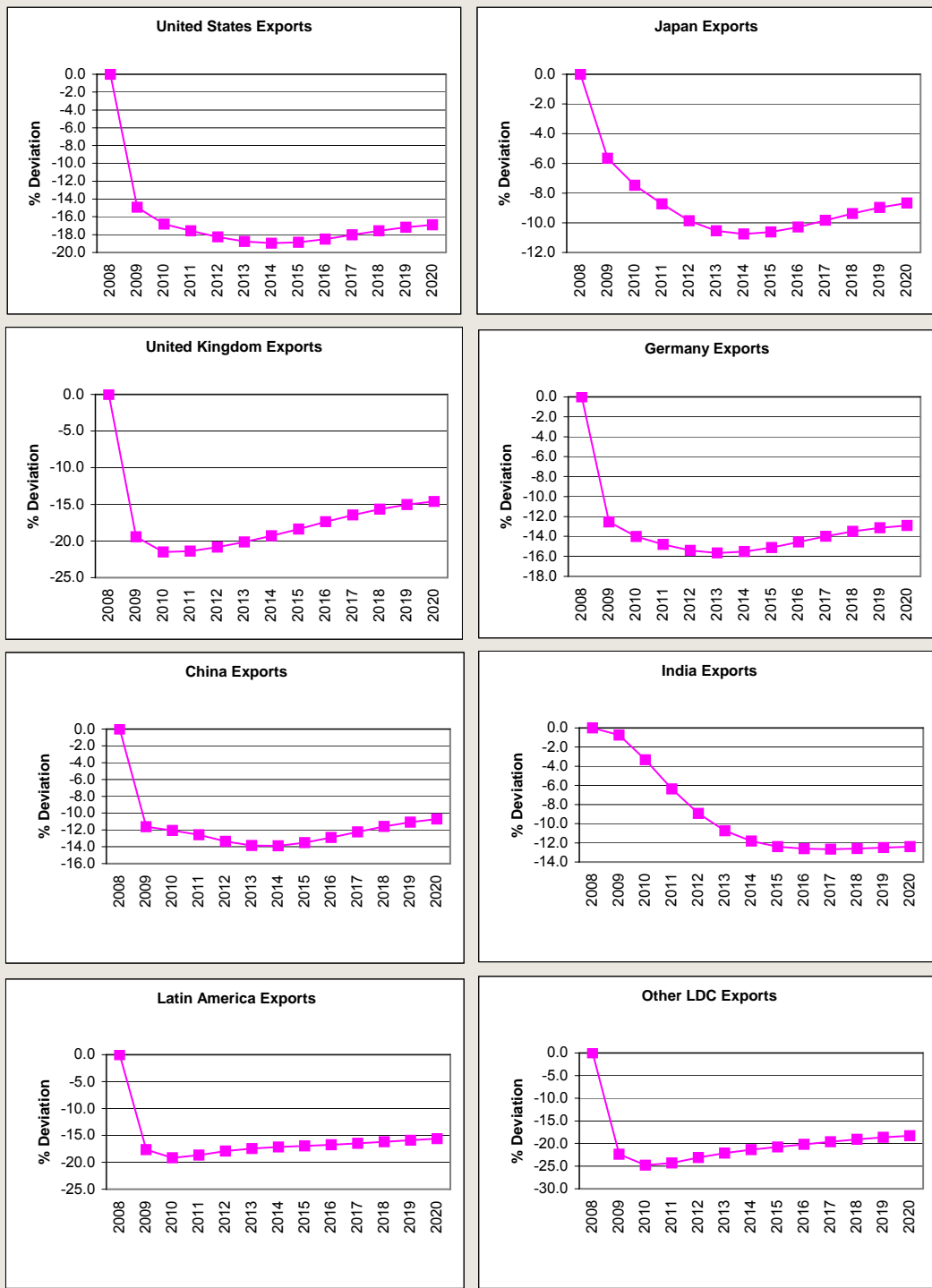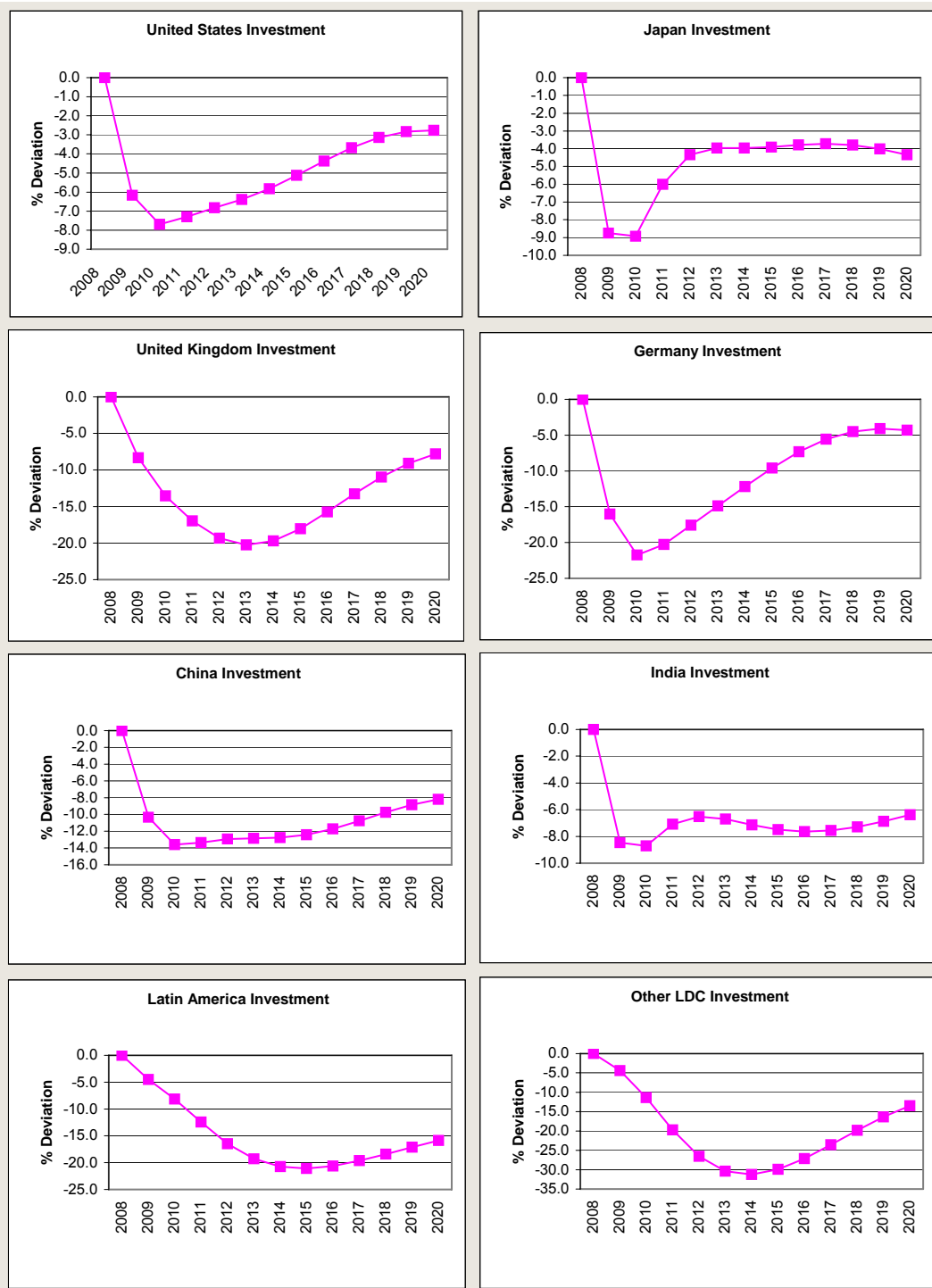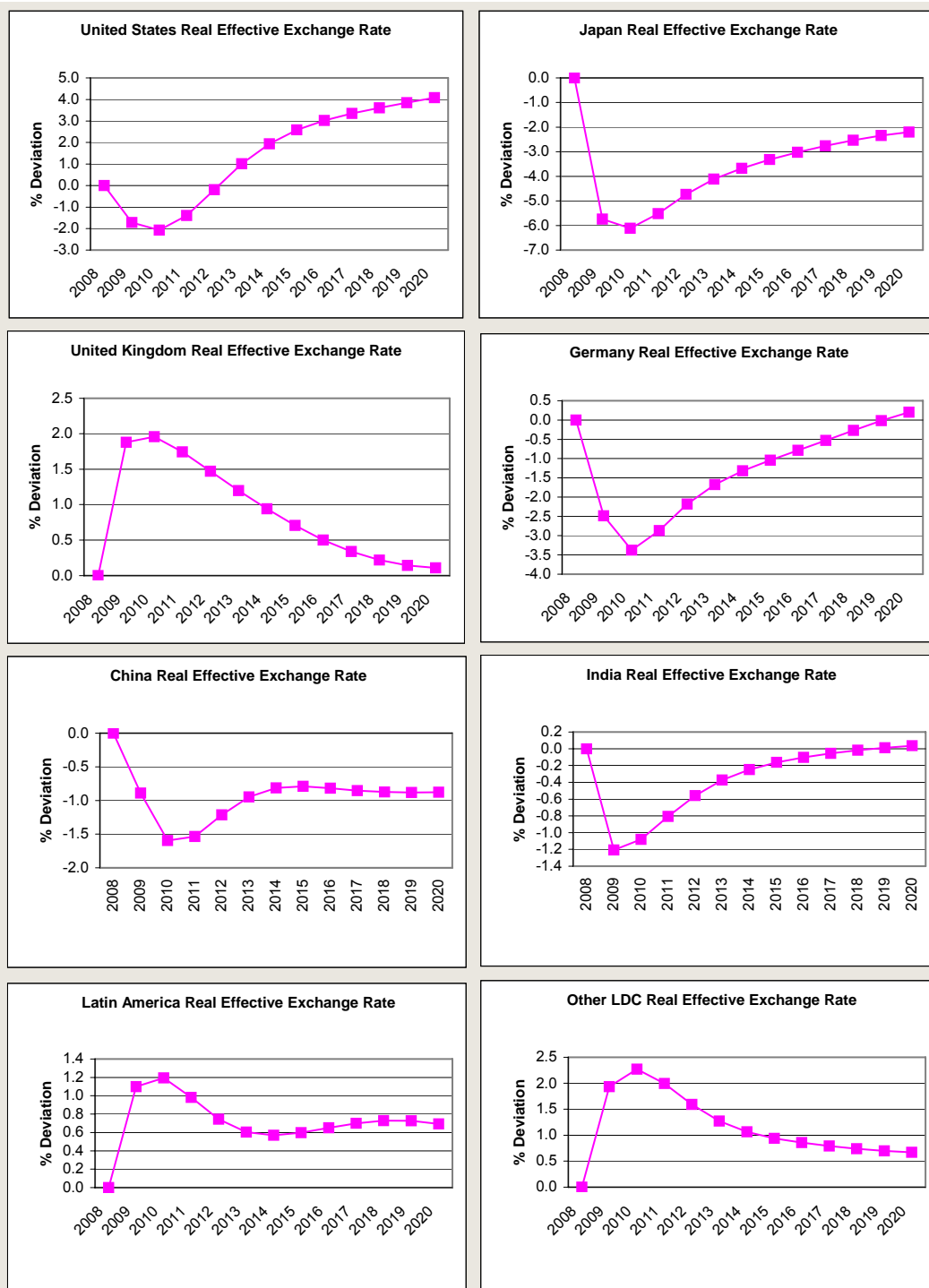
C.12 **Real interest rate effects of tariff rise**

Data source: G-Cubed model simulations

C.13 **Real effective exchange rate effects of tariff rise**

Data source: G-Cubed model simulations

C14 **Additional Variables for GFC**

(% deviation from baseline)	Gross Domestic Prod		Total Employment	
	2009	2010	2009	2010
United States	-3.51	-3.24	-7.19	-5.64
Japan	-1.63	-1.36	-3.59	-1.56
United Kingdom	-4.02	-3.35	-7.72	-5.41
Germany	-3.71	-2.96	-7.92	-4.16
Euro Area	-3.35	-3.05	-7.20	-5.17
Canada	-2.17	-1.94	-5.23	-3.64
Australia	-0.67	-0.82	-3.70	-2.57
ROECD	-2.87	-2.62	-5.67	-3.67
China	-4.39	-3.50	-9.63	-5.33
India	-1.06	-0.87	-4.64	-2.29
Other Asia	-1.29	-1.22	-5.84	-3.02
Latin America	0.27	-0.34	-2.86	-2.15
Other LDC	1.36	0.36	-0.64	-1.21
EEFSU	-1.75	-1.31	-6.69	-3.20
OPEC	-3.57	-2.37	-11.47	-3.75

C15: **Additional Sectors Variables**

Outut Prices

(% deviation from baseline)	Energy		Mining		Agriculture		Durable Manufacture		Non-Durable Man		Services	
	2009	2010	2009	2010	2009	2010	2009	2010	2009	2010	2009	2010
United States	-8.80	-5.30	-8.99	-6.66	-6.51	-4.28	-10.05	-7.46	-5.98	-3.57	-6.45	-3.42
Japan	-3.95	-2.86	-4.49	-3.71	-2.28	-2.71	-5.45	-4.28	-2.42	-2.68	-3.26	-3.14
United Kingdom	-9.66	-6.20	-9.39	-6.79	-5.63	-4.15	-9.38	-7.15	-6.19	-4.25	-7.14	-4.29
Germany	-7.85	-6.33	-7.51	-6.48	-5.79	-5.89	-7.06	-6.83	-6.34	-5.81	-10.97	-7.48
Euro Area	-8.31	-5.52	-7.18	-5.67	-5.38	-4.06	-9.12	-7.26	-6.19	-4.39	-10.02	-6.20
Canada	-5.16	-2.52	-6.58	-4.45	-3.38	-2.37	-7.18	-5.52	-3.32	-2.07	-3.92	-2.23
Australia	-7.28	-3.72	-7.87	-4.89	-3.20	-1.18	-7.62	-5.05	-3.78	-1.48	-3.55	-0.98
ROECD	-7.03	-4.41	-5.84	-4.67	-4.58	-3.62	-6.83	-5.79	-4.07	-3.31	-5.55	-3.96
China	-10.05	-8.55	-9.09	-8.90	-4.93	-6.81	-11.50	-10.07	-6.70	-7.22	-9.93	-8.69
India	-6.68	-4.05	-8.13	-5.88	-3.39	-2.13	-9.06	-6.08	-4.89	-3.08	-6.66	-3.59
Other Asia	-10.45	-7.47	-10.29	-8.26	-5.69	-5.39	-11.77	-9.24	-7.06	-5.93	-8.28	-6.20
Latin America	-6.85	-4.27	-8.51	-6.10	-4.15	-2.86	-10.48	-7.65	-4.58	-3.06	-4.15	-2.61
Other LDC	-7.50	-4.29	-6.76	-4.06	-1.33	0.10	-6.99	-4.58	-3.46	-1.56	-2.13	-0.54
EEFSU	-9.36	-7.21	-9.28	-7.67	-6.54	-6.18	-9.77	-7.98	-7.45	-6.48	-8.33	-6.54
OPEC	-14.34	-10.59	-14.73	-12.20	-10.05	-11.16	-17.53	-13.31	-12.73	-11.00	-17.69	-12.53

Production

(% deviation from baseline)	Energy		Mining		Agriculture		Durable Manufacture		Non-Durable Man		Services	
	2009	2010	2009	2010	2009	2010	2009	2010	2009	2010	2009	2010
United States	-3.25	-3.01	-10.95	-11.16	-6.01	-5.63	-11.74	-12.66	-3.99	-2.74	-3.85	-3.10
Japan	-1.42	-0.65	-5.27	-3.30	-2.33	-1.09	-6.11	-4.56	-2.03	-0.68	-2.16	-1.17
United Kingdom	-4.25	-3.32	-12.12	-12.24	-6.79	-4.99	-12.40	-12.03	-5.21	-3.10	-4.63	-3.34
Germany	-3.46	-1.65	-5.86	-5.19	-5.63	-3.01	-9.85	-8.12	-3.90	-1.59	-2.75	-1.92
Euro Area	-2.51	-1.97	-5.60	-5.65	-4.86	-3.24	-8.69	-9.53	-4.27	-2.61	-3.28	-2.69
Canada	-1.40	-0.98	-8.16	-8.68	-3.71	-3.06	-9.59	-10.21	-2.68	-1.60	-2.88	-1.89
Australia	-1.98	-2.34	-5.60	-6.35	-1.66	-1.17	-5.78	-7.23	-1.27	-0.23	-1.54	-0.82
ROECD	-2.10	-1.43	-5.58	-4.95	-3.62	-2.30	-9.04	-8.75	-3.74	-1.79	-3.34	-2.18
China	-2.79	-1.85	-7.88	-6.45	-3.73	-2.21	-7.90	-6.85	-4.09	-1.98	-4.36	-3.05
India	-1.48	-1.28	-4.89	-5.02	-1.33	-0.32	-3.58	-4.16	-2.36	-1.26	-1.82	-1.35
Other Asia	-1.59	-1.30	-4.84	-4.36	-2.07	-1.00	-6.56	-6.21	-2.44	-1.09	-2.52	-1.55
Latin America	-1.86	-1.74	-7.16	-6.91	-2.03	-1.82	-4.71	-5.60	-0.42	-0.49	-0.80	-0.88
Other LDC	-1.95	-2.43	-2.76	-3.61	2.09	1.09	-1.36	-3.02	0.58	-0.02	0.53	-0.08
EEFSU	-2.87	-1.77	-6.28	-4.91	-2.37	-1.33	-6.85	-5.58	-2.47	-1.17	-2.25	-1.29
OPEC	-1.08	0.20	-7.20	-3.50	-9.54	-3.82	-8.03	-5.38	-7.59	-2.72	-4.53	-2.23