

SPILLOVERS ENTRE PAÍSES EJEMPLOS USANDO EL MODELO NIGEM

Moritz Roth y Daniel Santabárbara

DESARROLLOS RECIENTES Y HERRAMIENTAS PARA EL ANÁLISIS DE LA
SITUACIÓN ECONÓMICA

Madrid

05.06.2019

ECONOMÍA INTERNACIONAL Y ÁREA DEL EURO



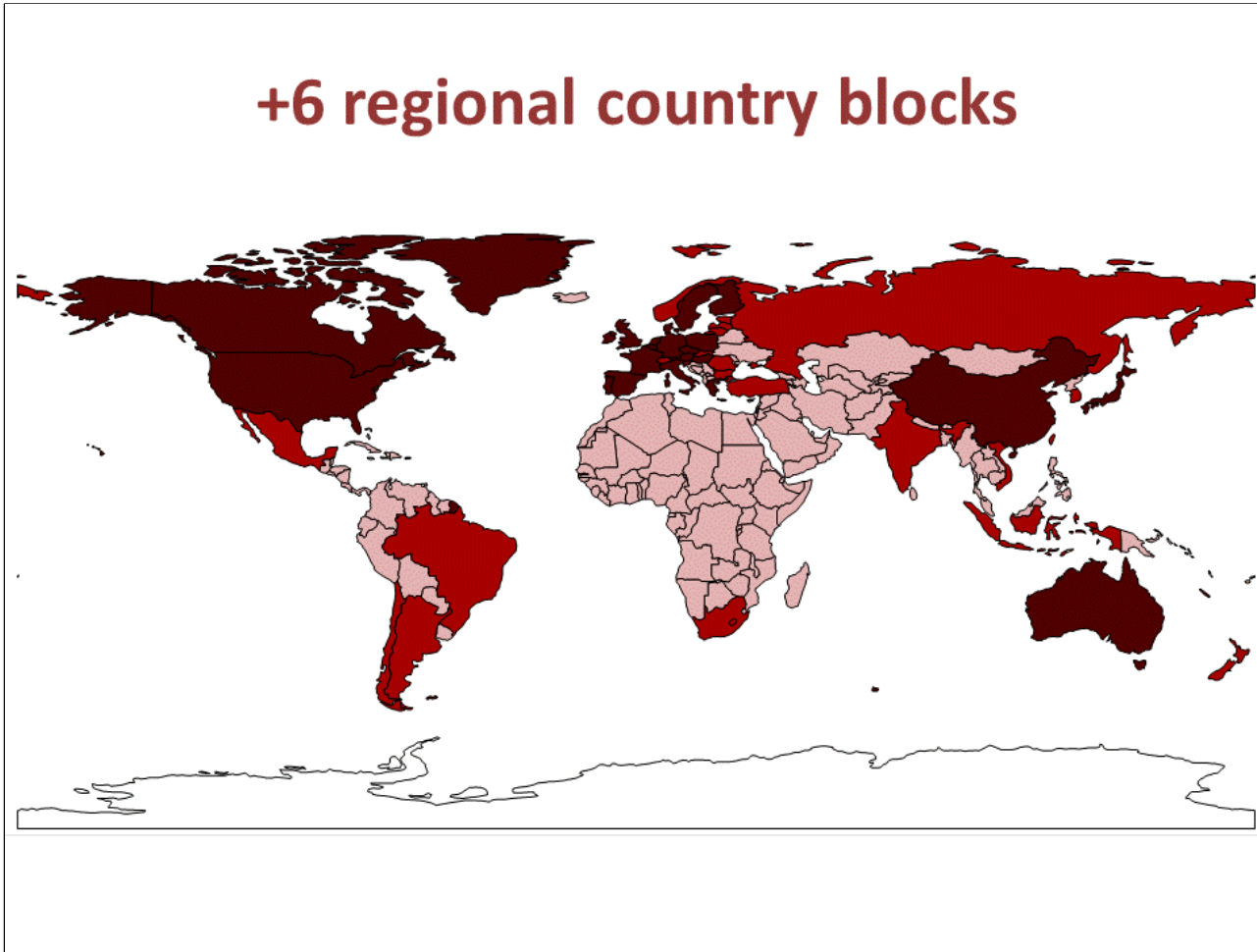
- **NIGEM overview**
- **China's economic rebalancing (May 2019)**
- **US-China trade war (Apr 2018)**
- **US monetary policy spillovers (Sep 2018)**
- **Brexit scenarios (Dec 2018)**
 - Migration
 - Trade



- NiGEM is a large model of the world economy and is used at the Banco de España for scenario analysis and stress testing
- Discrete models for most OECD and major economies and there are regional blocks for the remaining countries in Asia, America, Africa, the Middle East and Europe
- Models depend on both theory and data
- Economic agents: households, firms, governments and central bank
- There is a common (estimated and calibrated) underlying structure across all economies
- Long-run structure relatively rigid
- Contains both forward looking, rational expectations and adaptive learning.
- Flexible policy environments



+6 regional country blocks





- The country models have complete demand and supply sides, also full asset structures
- Most behavioural equations estimated in error-correction format
- Rational expectations options
 - financial markets
 - labour markets
 - consumption
- Country Linkages
 - trade and competitiveness
 - interacting financial markets (integrated capital markets)
 - through international stocks of assets

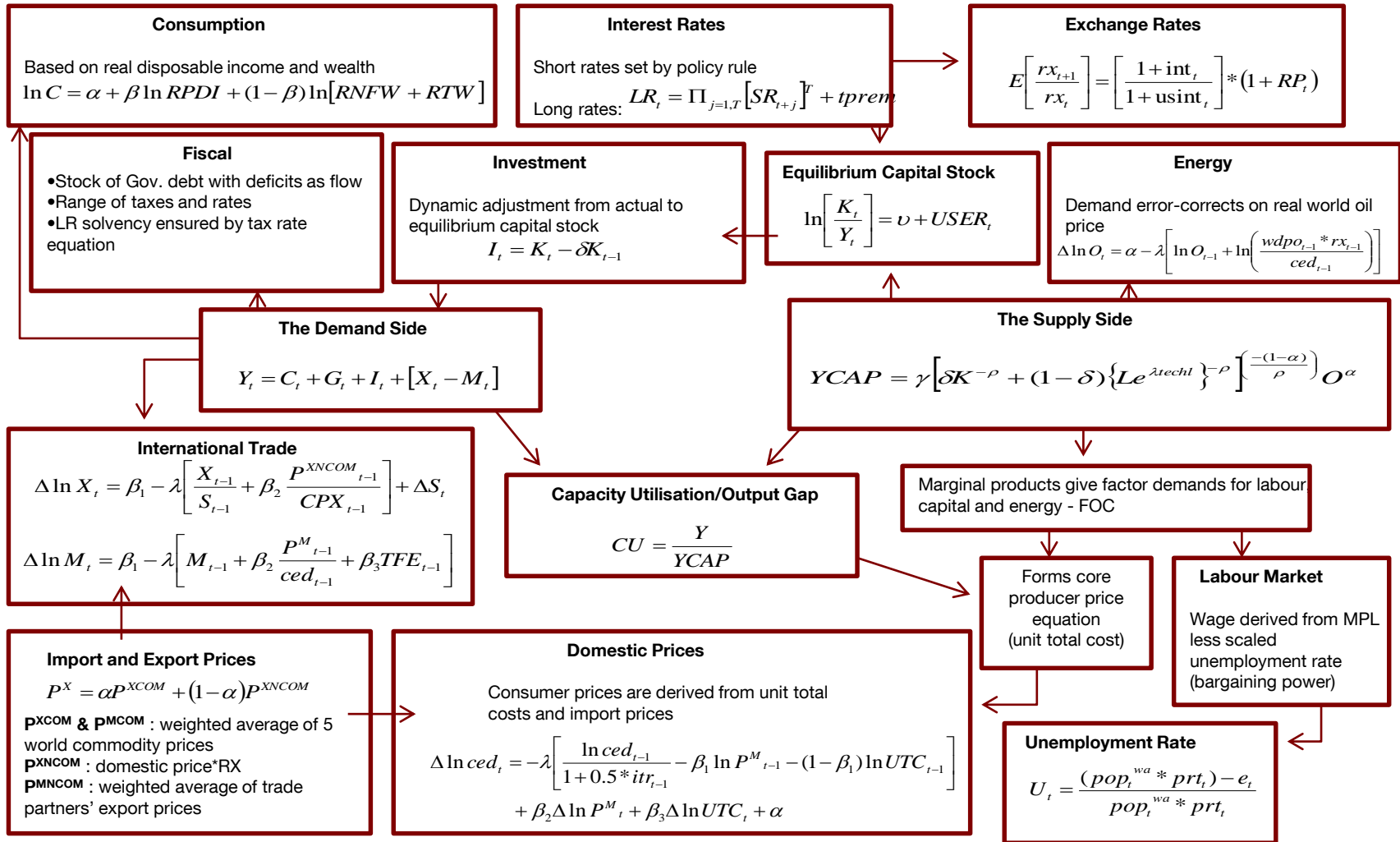
Supply-side

- based on CES relationship between capital (K) and labour (L), embedded in a Cobb-Douglas framework with oil (M)

Policies

- direct and indirect taxes, government spending and interest payments
- tax rule to ensure long-run solvency
- flexible monetary policy options

STRUCTURE OF THE MODEL



OUTLINE



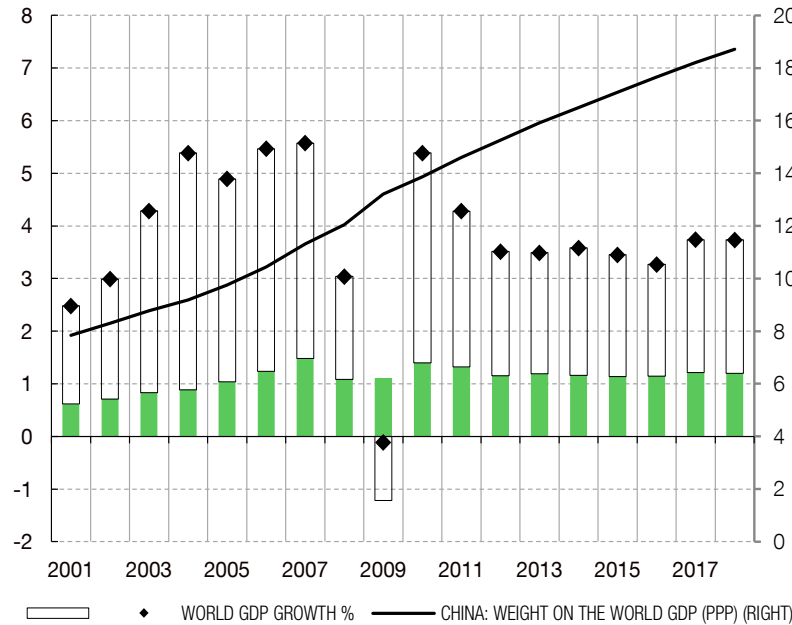
- **NIGEM overview**
- **China's economic rebalancing (May 2019)**
- **US-China trade war (Apr 2018)**
- **US monetary policy spillovers (Sep 2018)**
- **Brexit scenarios (Dec 2018)**
 - Migration
 - Trade



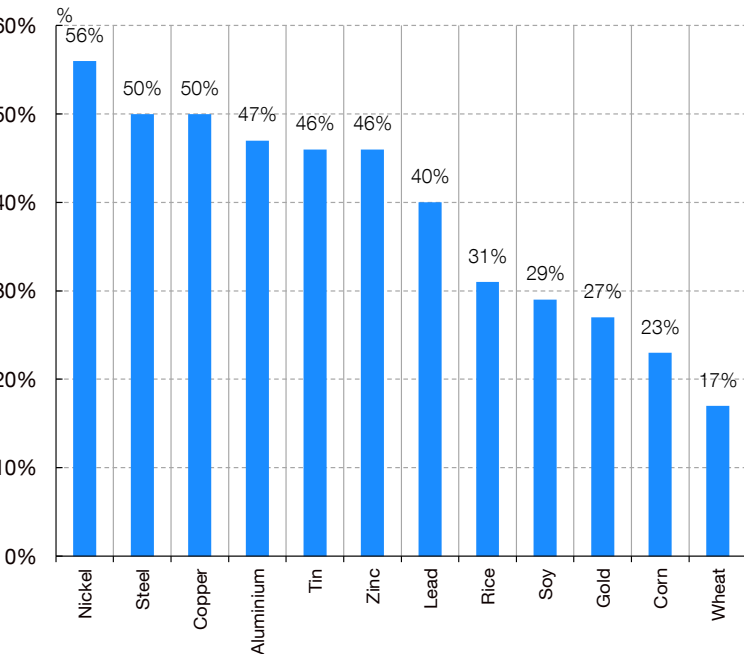
Exercise conducted in May 2019

- Government to shift away from short-term growth towards sustainable growth in the medium and long term
- China's linkages with other regions are rapidly increasing...
- ... transmitted to the rest of the world through various direct and indirect channels (trade channel, commodity prices, financial and confidence)

1 CHINA: WEIGHT AND CONTRIBUTION ON THE WORLD GDP PPP %



2 SHARE OF CHINA IN THE WOLD CONSUMPTION OF COMMODITIES %



SOURCES: IMF, WEO October 2018, World Bank, UN, BP Energy Outlook, Wall Street Journal, World Gold Council



CALIBRATION

- **Real channel**
 - 1pp fall in China's potential growth relative to the NiGEM baseline
 - *Fall materializes through the domestic demand (DD) variable, implemented from 2019 onwards as well as potential growth*
 - *Rebalancing the Chinese growth model*
 - 80% of the fall in domestic demand is accounted for by a fall in domestic investment
 - 20% by a fall in domestic consumption (Asian Development Bank, 2016)
 - *Since policies output gap has not changed, neither monetary nor fiscal policy react to the fall in potential growth...*
 - *... but monetary policy might react to inflation created by the growth shock*



CALIBRATION

• Commodity Price Channel

- China accounts for a large part of world demand for commodities (metals & oil)
 - *NiGEM barely endogenizes this channel, so we reinforce it with additional calibration*
 - Based on Atanu and Madhavi (2016) we calibrate that a 1pp drop in potential growth in China will lead to a 6.9% fall in global oil prices and a 7.8% fall in global metal prices after 1 year
 - For commodity producers, we calculate the effect of these price changes on their commodity production
 - *Oil: based on Oil rents as % of GDP data (Worldbank) and a supply elasticity of 0.13 (Caldara, Cavallo and Iacoviello, 2017)*
 - *Metals: based on the Metallic Mineral and Coal production share as % of GDP (ICMM) and a metal supply elasticity of 1.1 (weighted average over elasticities of individual metals by Stuermer, 2017)*
 - *Given the price changes and supply elasticities we calculate the effect on the domestic demand of commodity producers to these price changes, again we fix the corresponding output gaps*



CALIBRATION

- **Confidence Channel**

- Potentially large spillovers on global financial markets (Metelli and Natoli, 2017) and especially in EMEs
 - *Fall in equity prices in China, Europe, Japan and the United States (-10%)*
 - *Rise in equity risk premia (50bp)*
 - *Rise in term premia of EMEs (60bp)*

- **Technical assumptions**

- Model is solved under adaptive, backward-looking expectations
 - *No anticipated Price or Exchange rate effects*
 - *For China the results reflect effects excluding a potential depreciation of the RMB as a response to the growth slowdown*

NIGEM – SIMULATION RESULTS



- The combined scenario would result in a decline in global growth of 0.4 pp after one year.
 - This impact is delivered in equal measure by the trade and financial channels, with the channel of lower commodity prices being less relevant at global level.
- In fact, in advanced economies, the latter channel would have an expansionary effect, due to cheaper imports of commodities, curbing the effects of other shocks, so that the combined impact on the GDP would be 0.3 pp.
- The contraction in activity would be more pronounced in EMEs (0.5 pp), mainly affecting commodity producers and some Asian economies that have strong ties with China.

Table 1
IMPACT ON REAL GDP GROWTH (%) IN THE EVENT OF DIFFERENT SHOCKS (in pp)

Combined shock	Trade channel				Commodities channel				Financial channel							
	China	Adv. eco.	Emer. eco.	World	China	Adv. eco.	Emer. eco.	World	China	Adv. eco.	Emer. eco.	World	China	Adv. eco.	Emer. eco.	World
	1 pp fall in potential growth and rebalancing of final demand				-6.9 % in oil prices and -7.8 % in metal prices				10 % fall in stocks, 50 bp rise of equity risk premium and 60 bp rise in long-term interest rates in emerging economies							
t+1	-0.69	-0.27	-0.52	-0.41	-0.60	-0.07	-0.27	-0.19	0.07	0.08	-0.04	0.01	-0.09	-0.25	-0.15	-0.19
t+2	-0.68	0.14	-0.29	-0.11	-0.72	-0.04	-0.31	-0.20	0.15	0.18	0.15	0.16	-0.01	-0.02	-0.03	-0.02
Average	-0.68	-0.06	-0.40	-0.26	-0.66	-0.06	-0.29	-0.20	0.11	0.13	0.05	0.08	-0.05	-0.14	-0.09	-0.11

NIGEM – SIMULATION RESULTS



- This scenario would generate disinflationary pressures, more pronounced in emerging economies and, particularly, in commodity-producing countries.

Table 2
CHANGE IN INFLATION (%) IN THE EVENT OF DIFFERENT SHOCKS (in pp)

Combined shock	Trade channel				Commodities channel				Financial channel							
	China	Adv. eco.	Emer. eco.	World	China	Adv. eco.	Emer. eco.	World	China	Adv. eco.	Emer. eco.	World				
	1 pp fall in potential growth and rebalancing of final demand				-6.9 % in oil prices and -7.8 % in metal prices				10 % fall in stocks, 50 bp rise of equity risk premium and 60 bp rise in long-term interest rates in emerging economies							
t+1	-0.48	-0.34	-0.98	-0.71	0.00	-0.02	-0.10	-0.07	-0.45	-0.25	-0.72	-0.52	-0.02	-0.07	-0.14	-0.11
t+2	-0.27	-0.40	-1.11	-0.82	0.02	-0.05	-0.22	-0.15	-0.17	-0.11	-0.41	-0.29	-0.01	-0.05	-0.09	-0.07
Average	-0.37	-0.37	-1.04	-0.77	0.01	-0.04	-0.16	-0.11	-0.31	-0.18	-0.56	-0.41	-0.02	-0.06	-0.11	-0.09

NIGEM – SIMULATION RESULTS



- GDP growth in US, Euro Area, UK and Japan would fall between -0.2 pp and -0.3 pp
- In Latin America, the reductions in growth rates would be between -0.7 pp in Brazil and Argentina, and -1.4 pp in Chile. The negative spillovers are mostly transmitted through financial channel and commodity price channel in these economies
- In Asia, the impact varies between -0.3 pp for South Korea and -0.8 pp for Indonesia

Chart 1
IMPACT ON REAL GDP GROWTH - FIRST YEAR

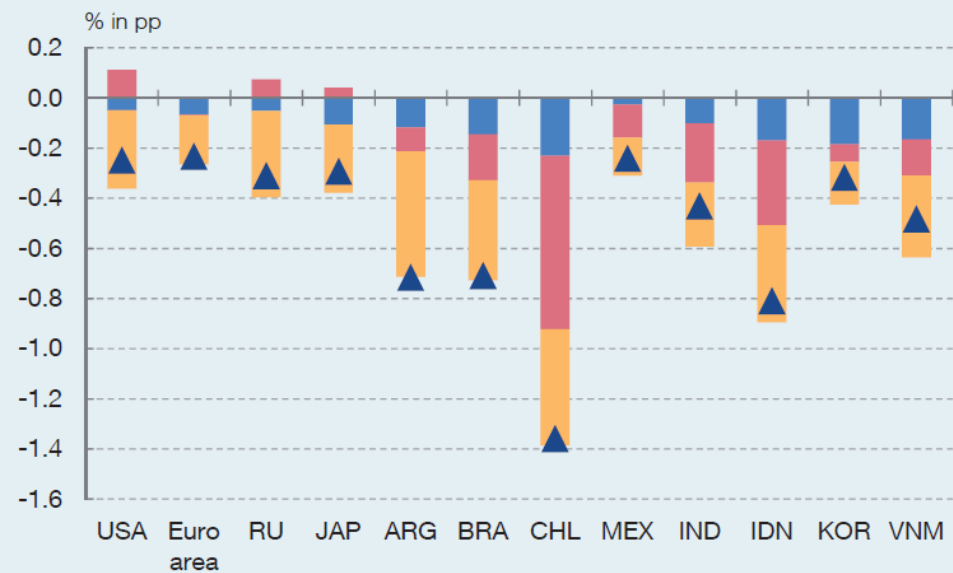
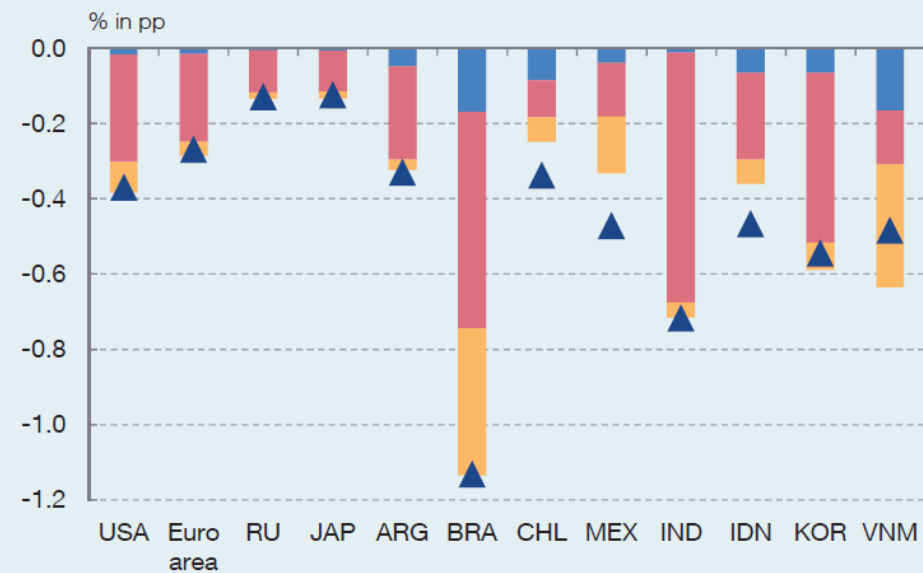


Chart 2
IMPACT ON ANNUAL INFLATION - FIRST YEAR



TRADE CHANNEL COMMODITIES CHANNEL FINANCIAL CHANNEL OVERALL SHOCK



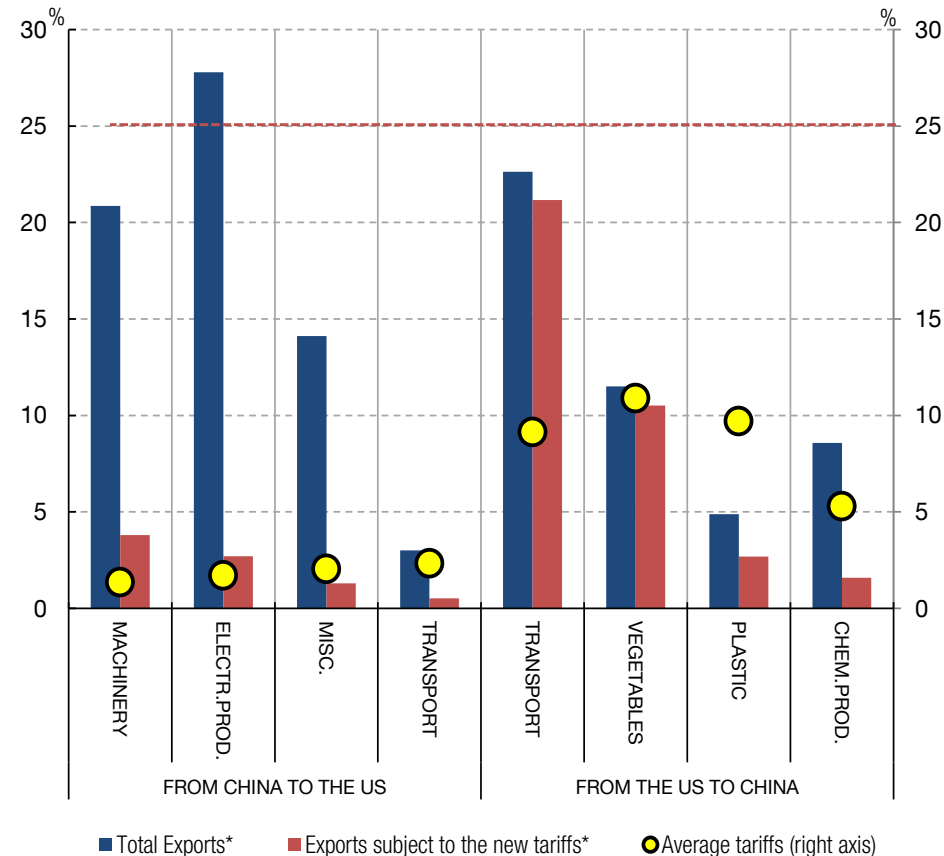
- **NIGEM overview**
- **China's economic rebalancing (May 2019)**
- **US-China trade war (Apr 2018)**
- **US monetary policy spillovers (Sep 2018)**
- **Brexit scenarios (Dec 2018)**
 - Migration
 - Trade



Exercise conducted in April 2018

- The US administration announced new tariffs on imports from China. Chinese authorities responded by announcing retaliatory measures
- Both the US and Chinese tariffs will be applied to key sectors, and will jointly cover 15% of bilateral trade flows
- The **US** announced the imposition of tariffs on **50 bn dollars** imports of high-tech products from China
 - Among the affected goods, electronic products, aircraft parts, chemical products, medicines and machinery
 - In general, tariffs will not be directed to final consumer goods
- **China** responded by announcing **retaliatory measures** covering an equivalent value of imports from the US of goods such as **soybeans, cars, chemicals and aircraft**
- As a response, Trump threatened to impose **additional tariffs on 100 bill USD** imports from China

BILATERAL EXPORTS BY SECTOR AND AVERAGE TARIFFS

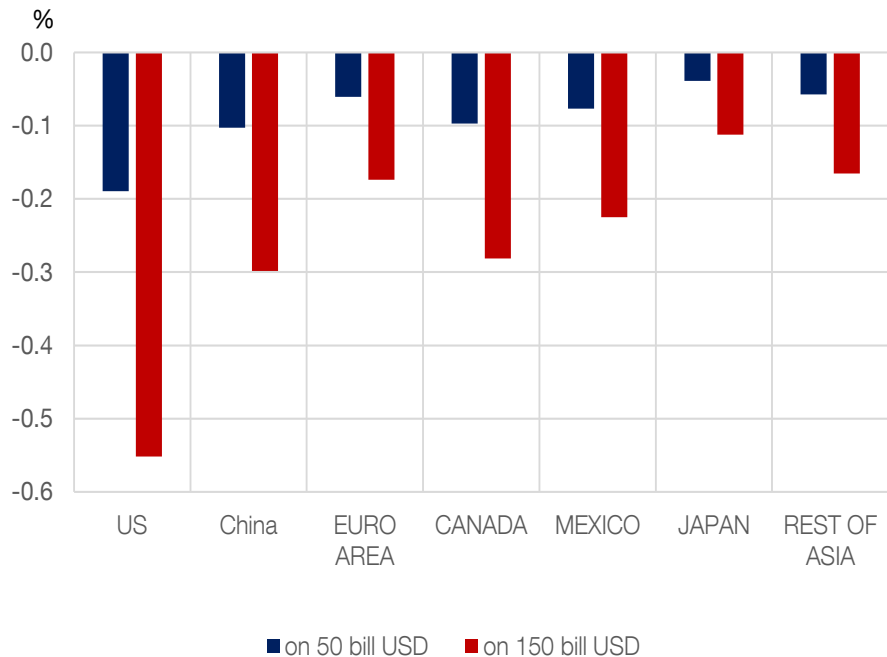


SOURCE: US INTERNATIONAL TRADE COMMISSION, PIEE AND OMC. 2017 DATA.
*Each sector exports: % of each country's exports.



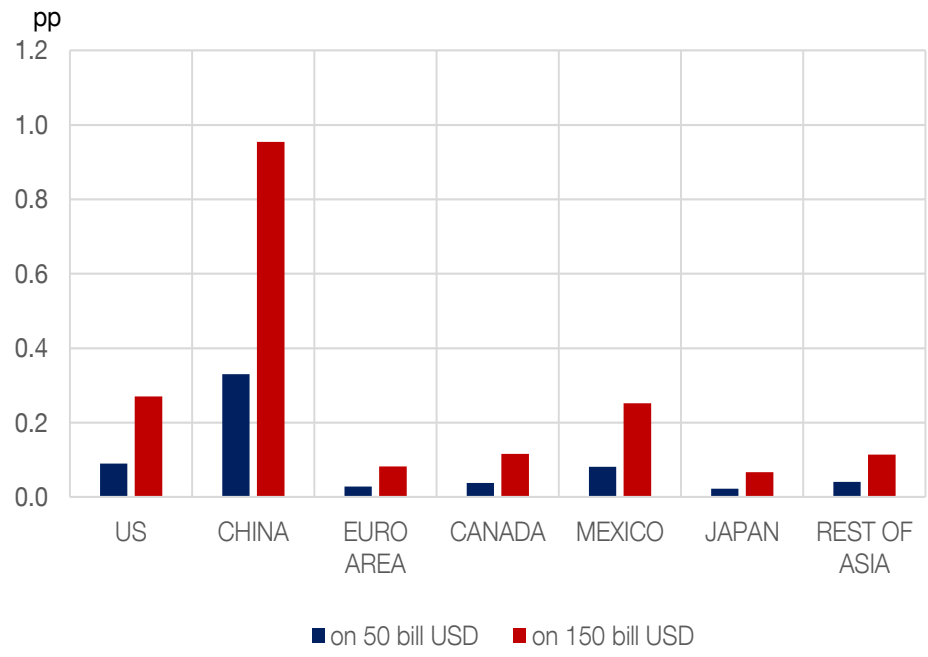
- **Scenario 1:** 25% tariff on USD 100 bn of US imported goods from China and retaliation of China on an equivalent import volume from the US
- **Scenario 2:** Same tariffs on USD 150 bn of import volumes
- Monetary policy is able to react to these measures within the model simulations

IMPACT ON GDP OF ANNOUNCED US AND CHINESE TARIFFS - 5 YEARS



SOURCE: OWN SIMULATIONS THROUGH NIGEM
*MAXIMUM DEVIATIONS FROM BASELINE

IMPACT ON INFLATION OF ANNOUNCED US AND CHINESE TARIFFS - 5 YEARS



SOURCE: OWN SIMULATIONS THROUGH NIGEM
*MAXIMUM DEVIATIONS FROM BASELINE

OUTLINE



- **NIGEM overview**
- **China's economic rebalancing (May 2019)**
- **US-China trade war (Apr 2018)**
- **US monetary policy spillovers (Sep 2018)**
- **Brexit scenarios (Dec 2018)**
 - Migration
 - Trade



Simulation exercise conducted in September 2018

Faster-than-expected Monetary Policy Tightening in US

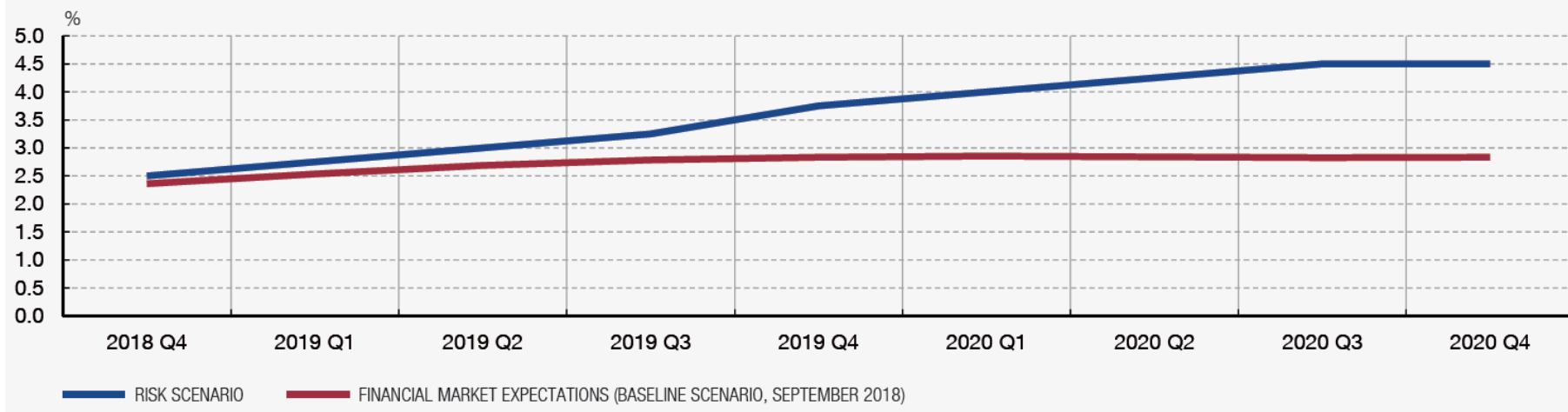
- The Fed had raised this rate on several occasions by 25 bp, to reach a range of 2%-2.25% by September 2018, and since October 2017 had been gradually reducing the size of its balance sheet.
- Against this backdrop, the appreciation of the US dollar and the rise in US government bond yields since the beginning of 2018 had prompted a tightening in the financial conditions faced by EMEs.
- This exercise assessed the potential impact of a more abrupt than expected normalization of monetary policy in the US on the financial markets of a series of emerging market economies (Brazil, Chile and Mexico in Latin America, and South Korea, Indonesia and China in Asia).



- **Faster-than-expected Monetary Policy Tightening**

- The risk scenario considered is one in which, unexpectedly, the federal funds rates rise more quickly, so that they stand at 4.5% at the end of 2020
- US term premium on ten-year US government bond yields assumed to stand at around 100 bp at the end of 2020, up from its level of -50 bp in September 2018 (an increase of 50 bp in 2018, 75 bp in 2019 and 25 bp in 2020)

Chart 1
FEDERAL FUNDS RATES IN THE UNITED STATES

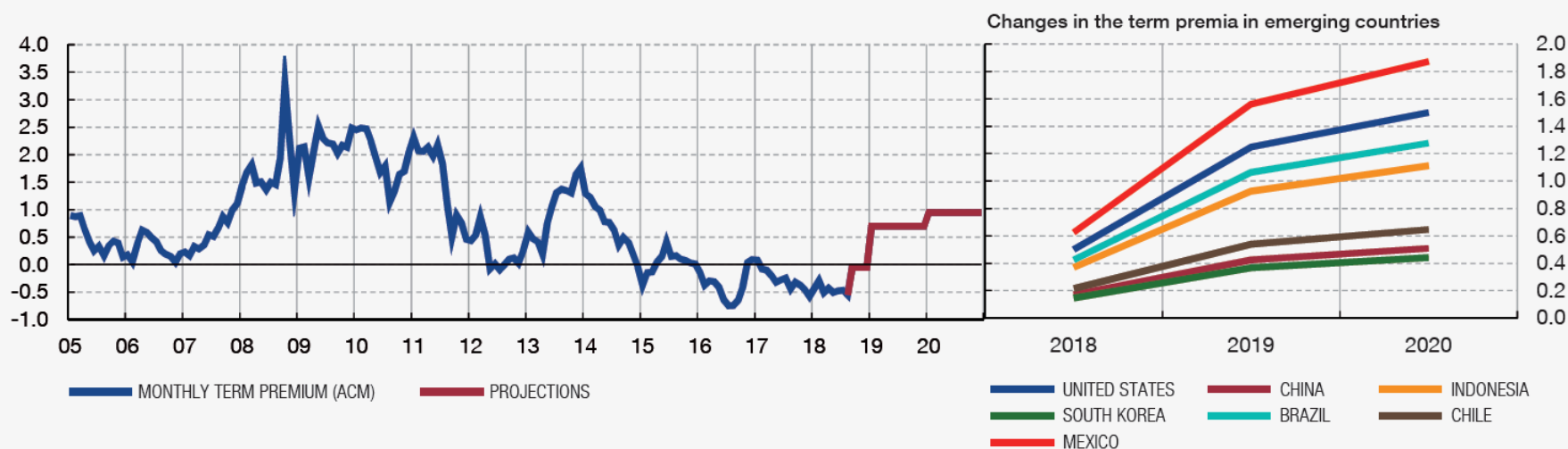




• Spillover Effects on EMEs

- US rate hike: empirical literature suggests that, faced with an unexpected rate hike by the Federal Reserve, the policy rates of the EMES increase, on average, ten times more than the federal funds rate (e.g. Mackowiak, 2007).
- US Term Premium: According to the elasticities estimated by Borrallo et al. (2016), the extent to which the increase in the US term premium is transmitted to emerging market economies depends on their macroeconomic fundamentals (see Chart 2).

Chart 2
UNITED STATES TERM PREMIUM



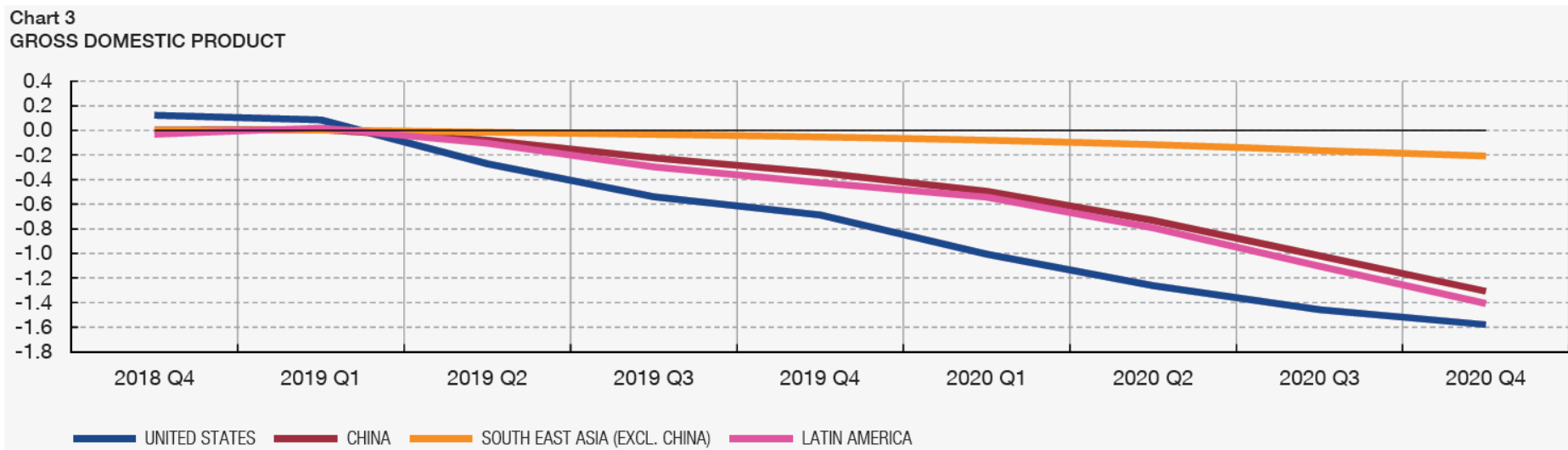
SOURCES: Banco de España calculations, Datastream, New York Federal Reserve, and Borrallo et al (2016).

NIGEM – SIMULATION RESULTS



• GDP Effects

- Under the risk scenario, GDP growth in the United States and in emerging market economies is lower, with the difference being greater with respect to the baseline scenario in the Latin American countries and China than in the rest of Asia
- For the Latin American countries in the sample, this is explained by the larger increase in the term premium, which causes a steeper drop in investment

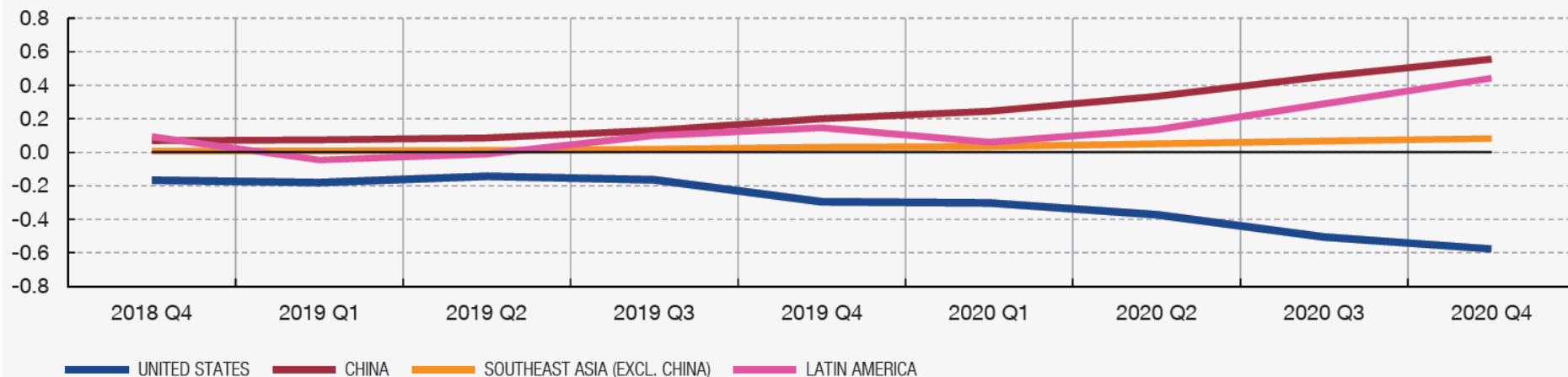




• Current Account Effects

- Under the risk scenario, the US dollar appreciates more in response to greater tightening of US monetary policy
- The current account of the United States deteriorates, while the external balance of the emerging market economies improves, with Latin America and China seeing a stronger improvement

Chart 4
CURRENT ACCOUNT BALANCE





- **NIGEM overview**
- **China's economic rebalancing (May 2019)**
- **US-China trade war (Apr 2018)**
- **US monetary policy spillovers (Sep 2018)**
- **Brexit scenarios (Dec 2018)**
 - Migration
 - Trade



- Simulation exercise conducted in December 2018
- Concrete backstop proposal for Brexit-Deal
 - Backstop would address Irish border issue by keeping a customs union between UK and EU after the transition period ends
- NiGEM baseline
 - Model baseline assumes a 'soft-Brexit':
 - *High level of trade interconnectedness*
 - *Internationally functioning financial markets*
 - *Comparable level of UK EU Budget contributions even after Brexit*
 - *21-month transition period*



Trade Scenario

- Estimation of **structural gravity models**
- Methodology outlined in Campos and Timini (2018)

- *Structural* trade gravity model in spirit of UNCTAD-WTO (2018)
- Conditional General Equilibrium (CGE) bilateral trade flows for a WTO scenario
- Data:
 - Bilateral trade flows (international and intra-national) from UN COMTRADE
 - Time period and frequency: 1986-2006 (four year frequency, following UNCTAD-WTO, 2016)
 - There are 69 (origin and destination) countries

Migration Scenario

- *Structural* migration gravity model in the spirit of Anderson (2011)
- Obtain Conditional General Equilibrium (CGE) bilateral migration flows in WTO scenario
- Data:
 - Bilateral migration flows from the International Migration Database (IMD, OECD)
 - Data are gross inflows to selected OECD destinations
 - Time period and frequency: 1997-2015 (yearly data)
 - There are 206 origin and 35 destination countries



Trade Scenario

Migration Scenario

- Estimation of **structural gravity models**
- Methodology outlined in Campos and Timini (2018)

trade volume (% change w.r.t. baseline)

Country	Scenario WTO	Scenario FTA
World Trade	-0.79	-0.62
GB	-25.87	-20.18
EU	-1.97	-1.53
USA	0.39	0.31
JAP	0.14	0.11
CHN	0.10	0.08
RoW	0.42	0.33

WTO Scenario

Net Flows (change respect to baseline)

number of persons per year	Net Flows (change respect to baseline)	
	<u>2018-22</u>	<u>2023-30</u>
UK	-173,313	-119,862
EU	127,634	88,828
USA	1,714	1,714
Japan	1,944	1,944
ROW*	42,022	27,376

* Calculated as a difference to total zero at the world level.



National Institute Global Economic Model:

- Backward-looking solution mode

Risk scenarios:

- Risk scenario for No-Deal Brexit
- Shocks implemented from Q2:2019 onwards
- No transition period
- Migration: Flow is yearly
- Trade: %-difference is from Pre-Brexit Steady State to Post-Brexit Steady State
- Full trade effect assumed to realize after 5 years, after economy stays at Post-Brexit Steady-State

Alternative Scenarios:

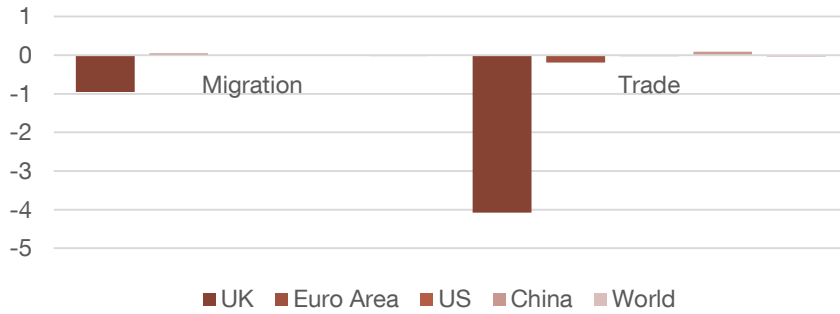
- Trade scenario:
 - Alternative assumptions of Steady-State transition in 3 years and 10 years
 - Transition period of 21 months and WTO rules thereafter
 - FTA

SCENARIO EFFECTS

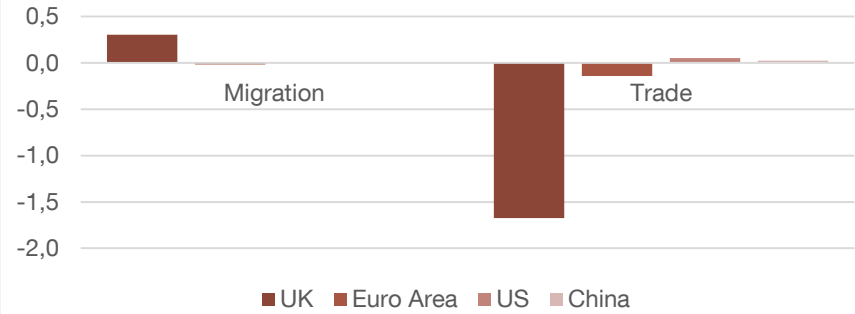


5 year effects

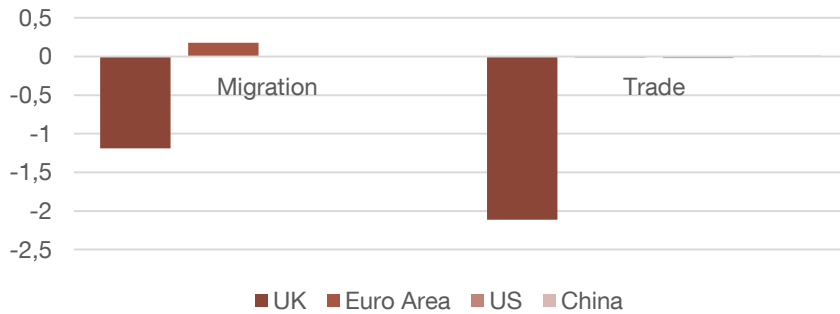
GDP



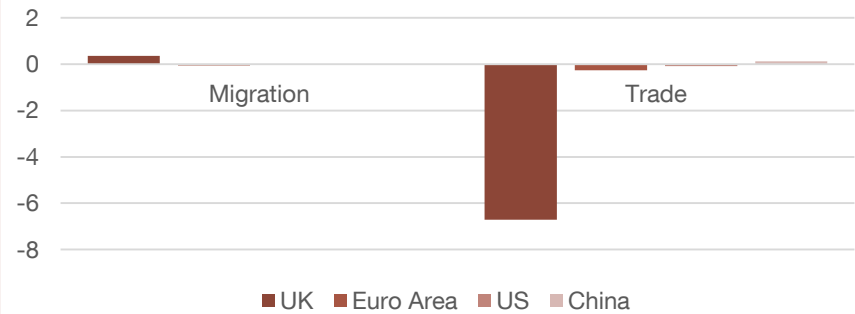
Inflation



Employment



Current Account

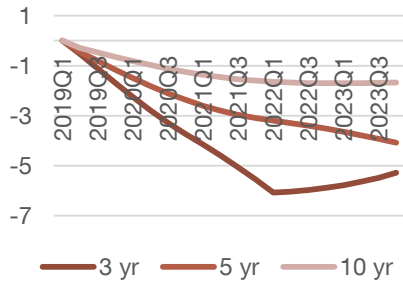


ROBUSTNESS: TRADE SCENARIO

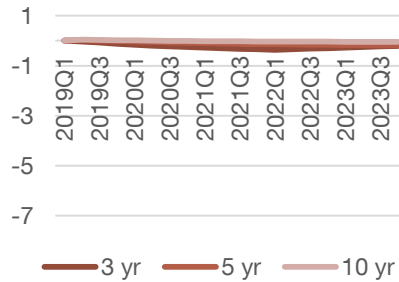


WTO

UK-GDP

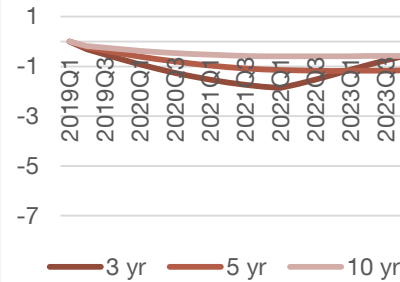


Euro Area GDP

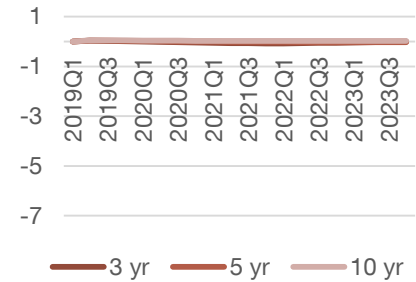


FTA

UK GDP

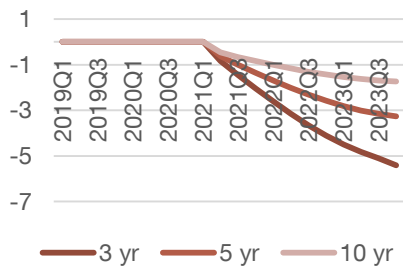


Euro Area GDP

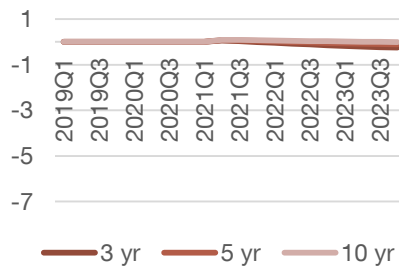


With transition

UK GDP

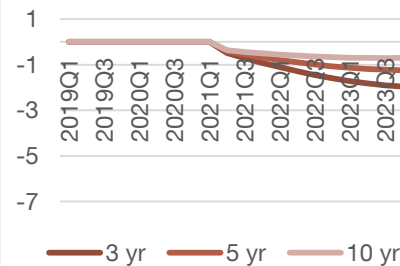


Euro Area GDP

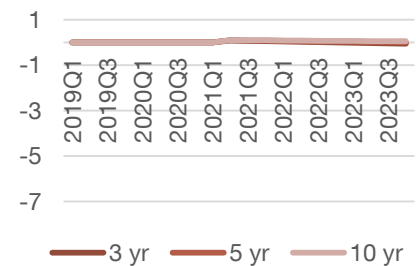


With transition

UK GDP



Euro Area GDP

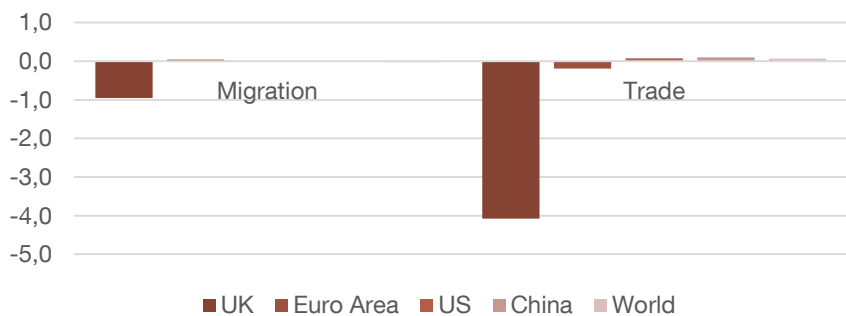


BREXIT: TRADE CANNEL EFFECTS

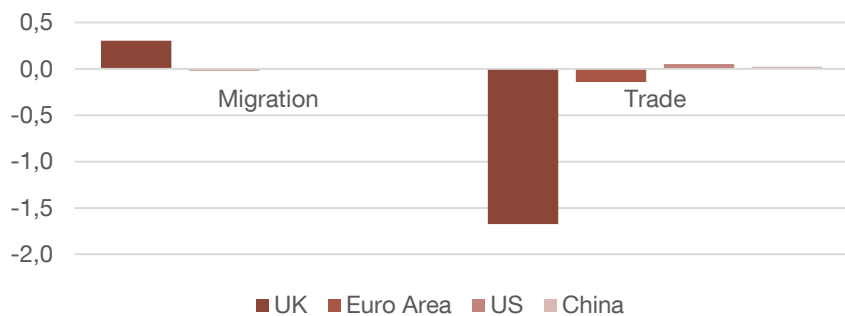


Maximum Effects

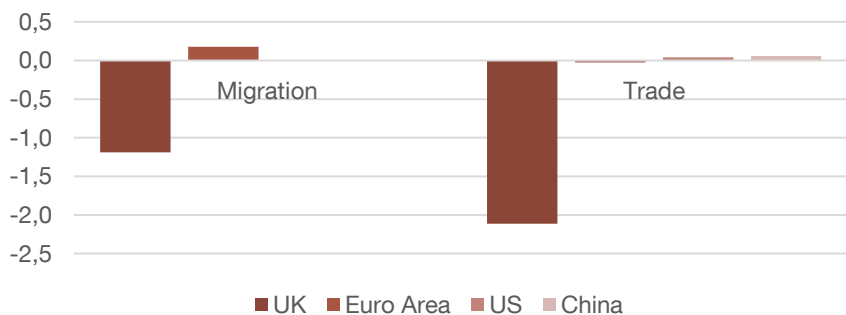
GDP



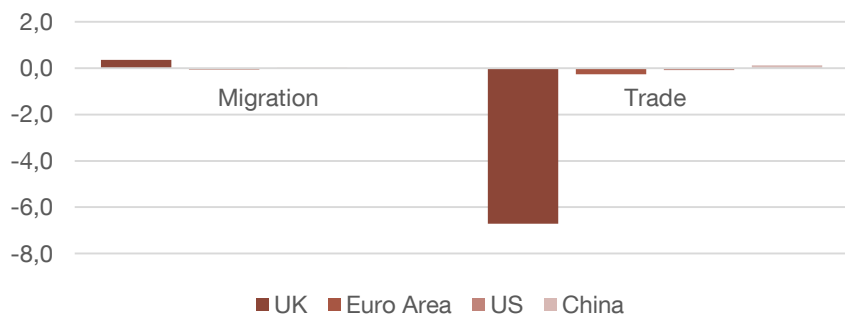
Inflation



Employment



Current Account



CONCLUSIONS



- NIGEM is used at Banco de España for simulation and stress testing purposes
- NIGEM simulations have been rather useful tool to illustrate the policy spillovers across countries
- Calibration is key to properly capture the spillovers
 - Empirical research
 - Historical evidence
- Some times it is necessary to adapt the equations to the problem considered
- Technical assumptions could compromise the results
 - Expectations
 - Policy reaction (monetary and exchange rates)



- Banco de España (2018), [El cambio de orientación de las políticas macroeconómicas en Estados Unidos](#), Boletín Económico del Banco de España, 01/2018, Informe trimestral de la economía española, Recuadro 2.
- Banco de España (2019), [El impacto global de una hipotética desaceleración económica en China](#), recuadro 1, capítulo 1, [Informe Anual 2018](#), Banco de España.
- Banco de España (2018), Implicaciones para las economías emergentes de un ritmo de endurecimiento de la política monetaria en EEUU más rápido de lo previsto, Recuadro 1 en [Informe de economía latinoamericana. Segundo semestre de 2018](#).
- Banco de España (2018), [Una estimación del impacto de las recientes medidas proteccionistas](#), Boletín Económico del Banco de España, 02/2018, Informe trimestral de la economía española, Recuadro 1.
- Berthou, A., Á. Estrada, S. Haincourt, A. Kadow, M. A. Roth y M.-E. de la Serve (2019), [Assessing the macroeconomic impact of Brexit through trade and migration channels](#), Documento Ocasional, 1911, Banco de España.
- Hantzsche, A., Lopresto, M., and Young, G. (2018), 'Using NiGEM in Uncertain Times: Introduction and Overview of NiGEM', National Institute Economic Review, No 244, May 2018



¡Gracias por su atención!