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The effect of a Chinese slowdown on inflation in the euro area and the United States☆

Luca Metelli, Filippo Natoli

Bank of Italy, Italy

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ABSTRACT

We investigate the effect of a Chinese slowdown on inflation in the euro area and the United States using the NiGEM multi-country model. We construct different scenarios including a fall in Chinese aggregate demand, a commodity price slump, financial market corrections and a devaluation of the renmimbi. While the commodity slump has the strongest impact on inflation, the demand and exchange rate shocks also play a role; on the contrary, financial turbulences have minor effects. Finally, we study the extent to which monetary policy in advanced economies can succeed in reflating the economy following such a Chinese slowdown. The room for central bank interventions is large.

1. Introduction

Since 2011, inflation in the euro area and the United States has been declining reaching values closes to zero (Fig. 1). Moreover, since 2014 also long term inflation expectations have been trending down, undershooting the respective inflation targets (Fig. 2). While part of the current disinflationary trend is related, especially for the euro area, to domestic factors, uncertainty about future growth prospects in emerging countries – especially in China – adds further concern. It is therefore important to investigate the potential spillovers that a marked slowdown in emerging economies could generate on advanced countries' inflation.

In this paper we study the impact of a possible Chinese slowdown on inflation in the euro area and the United States using the NiGEM, a multi-country New-Keynesian model designed by the National Institute of Economic and Social Research (NIESR). China's growth has slowed down in the last few years and concerns have been raised about the sustainability of its growth model (Eichengreen et al., 2012; Barro, 2016). Currently, the weakness of its imports, high indebtedness of its non-financial companies and uncertainty about its policy strategy are weighing on international trade flows, commodity prices and financial markets; moreover, capital outflows from China could become unsustainable such that the Chinese central bank stops defending its currency, triggering a devaluation of the renmimbi and possible concomitant devaluations of other managed Asian currencies.

We construct different scenarios to investigate the effects of a marked Chinese slowdown, that we define as a "hard landing". In particular, we assume a fall in Chinese investments, a negative shock to oil and metal prices and a global stock market correction. The analysis is split into three steps. In the first one, we assume that the Chinese authorities keep the renmimbi exchange rate fixed vis-a-vis the US dollar, and that central banks in the euro area, United States, United Kingdom and Japan do not undertake any actions in response to the shock.[1] In the second one, we maintain the assumption on the Chinese exchange rate but we allow central banks to react. A special focus of the analysis is made on the case of the euro area: with policy rates at zero and an ongoing asset purchase programme, we draw some insights on the monetary policy space still available to counter further deflationary pressures. In the third step, we impose a strong depreciation of the renmimbi vis-a-vis the US dollar, that could be motivated by a desire by the Chinese authorities to halt increasingly expensive currency interventions. We extend the latter scenario by imposing a simultaneous devaluation of other Asian currencies in light of their documented comovement with the renmimbi (Ito, 2008, 2010; Fratzscher and Mehel, 2014; Eichengreen and Kawai, 2015).

The main results of our simulation exercise are the following.

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E-mail addresses: luca.metelli@bancaditalia.it (L. Metelli), filippo.natoli@bancaditalia.it (F. Natoli).

[1] In December 2015, the PBOC has announced the introduction of a new currency index, signaling the intention to peg to a basket of foreign currencies instead of the US dollar only. Since then, however, the renmimbi has remained substantially anchored to the US dollar (less than 1% devaluation): in light of this, we still consider the US dollar peg as a reasonable assumption in the first two steps of our analysis.

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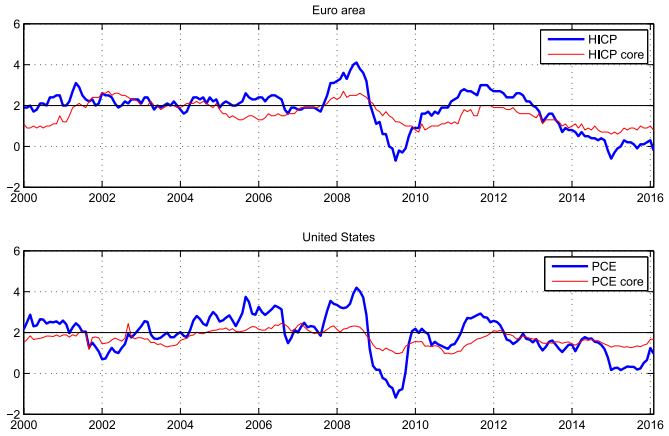

Fig. 1. Inflation, Fig. 1 reports HICP inflation for the euro area and PCE inflation for the United States. Core indexes are all items less food and energy.

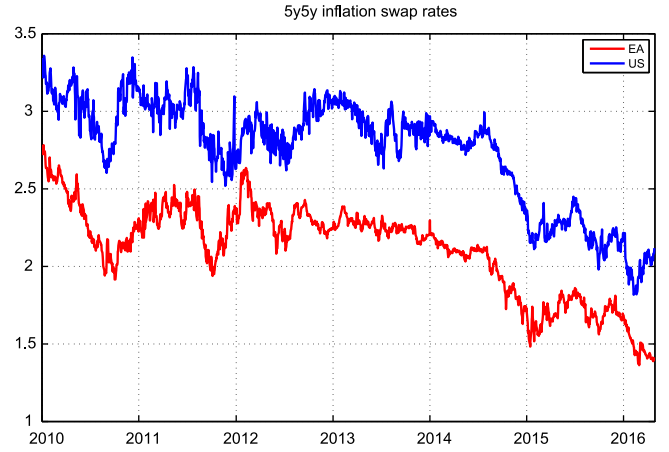

Fig. 2. Long-term inflation expectations, Fig. 2 reports long-term inflation expectations proxied by 5y5y forward inflation swap rates. The underlying inflation indexes are the HICPxT for the euro area and the CPI for the US.

Evaluating the effects over the first two years, we find that the negative commodity price shock has the strongest impact on inflation in both the euro area and the US; the slowdown of Chinese growth and the depreciation of the renmimbi also play an important role, but their effects are lagged. By contrast, the financial shock and the devaluation of other Asian currencies have minor effects on inflation. Concerning central bank reactions, we find that monetary policy in the euro area and the US can offset part of the disinflationary spillover.

Our main contribution is to carry out a comprehensive investigation of the main transmission channels to foreign inflation of a wide range of shocks hitting the Chinese economy, including financial shocks and exchange rate shocks. Recent papers that have simulated the spillover effects of a Chinese hard landing include Ahuja and Nabar (2012), OECD (2015), IMF (2015), Gauvin and Rebillard (2015) and Kireyev and Leonidov (2016); however, they have mainly evaluated the transmission to GDP growth rather than inflation. We also contribute to the ongoing debate on available monetary policy space in advanced countries by studying the effectiveness of monetary policy responses, both conventional and unconventional.

The advantages of using the NiGEM model for this exercise are twofold. First of all, a framework that links a large number of countries (more than 50) is suitable to reproduce the propagation of shocks through a network of trade linkages or the cross-border impact of financial shocks through internationally diversified portfolios.[2] Secondly, being microfounded, the model incorporates the structural characteristics of each economy (e.g., different degrees of price stickiness) and allows flexible specifications of the shocks; the shortcoming is that the identification of each transmission channel is not straightforward.

The rest of the paper is organized as follows. Section 2 presents a brief overview of the main features of the NiGEM and describes the main transmission channels to inflation. Section 3 describes the results under the assumption that major central banks do not react. Section 4 proposes the alternative scenario, in which central banks in the major advanced economies respond to the previously described shocks. Section 5 investigates the effects of the devaluation of the renmimbi and of other linked Asian currencies. Section 6 concludes.

2. Model features and transmission channels

2.1. Overview of the NiGEM

The NiGEM is a global framework that comprises more than 50 economies, some of them modeled individually, the others as regional blocks.[3] For all economies there are equations specifying domestic demand, export and import volumes, prices and the current account. The demand side affects output in the short-run, while a production function including labor, capital and oil usage determines the long-term steady-state; there is a government sector and different alternative specifications for the short-term interest rate, among which the Taylor rule and the possibility of pegging monetary policy to the United States or the euro area.

Economic agents set wages and prices in a forward-looking manner; equity prices are the discounted value of future profits of firms; long-term interest rates are the convolution of future short rates; finally, the uncovered interest rate parity (UIP) links the short-term rate and the exchange rates of countries that have an autonomous monetary policy. Consumption and investment depend on present discounted income and wealth and on the expected interest rate path. The framework is partly calibrated and partly estimated; a dynamic error-correction structure allows the model to adjust gradually towards equilibrium in response to shocks.

Economies are linked through trade, competitiveness and financial markets. Demand for exports equals total imports across the world, and exchange rate fluctuations and changes in export prices affect the relative price competitiveness of each country. Agents hold a portfolio of domestic and foreign bonds and equities, so that volatility in the price of these assets creates cross-country spillovers through wealth effects in foreign portfolios. Commodity prices depend on global export prices of non-commodities and on the intensity of commodities of output in each economy; however, commodity demand is not significantly responsive to aggregate demand shocks, and this is particularly an issue in countries, like China, in which aggregate demand is highly commodity-intensive.

2.2. Transmission channels to foreign inflation

In the NiGEM, consumer prices are a function of a domestic component, i.e. unit total costs of inputs, and a foreign one, i.e. the

[2] Two types of indirect or third-party effects on inflation are relevant in our simulation: (1) the induced growth slowdown in South Korea and other Asian countries amplifies the fall in euro area and US export volumes and import prices; (2) the slowdown in commodity exporters' growth – notably Russia, the Middle East and African countries – that follows the commodity price shocks adds further negative price pressures in the advanced economies.

[3] The main properties of the NiGEM are discussed in Barrell et al. (2004). The structure of the equations can be found on the Niesr website (http://www.niesr.ac.uk. Most OECD economies and other advanced and emerging countries are modeled individually, while regional blocks are Latin America (excluding Brazil), Africa (excluding South Africa), East Asia, Developing Europe, OPEC countries and a miscellaneous group comprising mainly countries in West Asia.

Table 1
China investment shock: Inflation (*left panel*), GDP growth (*right panel*).

Inflation			GDP		
	EA	US		EA	US
1st year	−0.1	−0.1	1st year	−0.3	−0.2
2nd year	−0.4	−0.4	2nd year	−0.2	−0.0

Table 1 (*left panel*) reports the impact on euro area and US inflation of the Chinese investment shock, in percentage points of deviation from the baseline inflation rate. Table 1 (*right panel*) reports the impact on GDP growth, in percentage points of deviation from the baseline growth rate.

prices of imported goods and services, split into commodities and non-commodities. In this framework, a shock to investment demand in China is expected to impact inflation abroad via two main channels. First, it induces a slowdown in the export volumes of trading partners, lowering their aggregating demand and therefore generating downward pressures on inflation. Secondly, weak aggregate demand in China puts negative pressure on domestic prices, lowering the prices of Chinese non-commodity exports: absent an adjustment of the exchange rate (e.g. if the renmimbi is anchored to the US dollar), in other countries this translates into lower consumer prices through imported deflation; the extent to which the export of low-value added Chinese goods have been relevant in affecting foreign inflation has been discussed within the *China Price* debate of the '90s and 2000s (e.g., Granville et al., 2011).[4] Finally, indirect spillovers arising from the Chinese slowdown might also be relevant in the NiGEM: the fall in Chinese imports reduces aggregate demand for major exporters to China, mainly Asian countries, adding to the disinflationary spillovers to the euro area and the US through the same aforementioned channels.

Concerning the shock to oil and metal prices, the NiGEM allows to identify the direct effect on country's consumption price index, as well as two indirect transmission channels. The first works through lower unit total costs: a reduction in commodity prices translates into lower marginal production costs, which are then passed to consumer prices; however, given that firms are monopolistically competitive and the economy features price stickiness, this effect is expected to be lagged. The second is a *third-party* spillover: commodity producers experience negative price pressures from subdued aggregate demand, and this may spill over abroad via lower prices of non-commodity imports for foreign countries.

Regarding the financial shock, an increase in equity risk premia entails (1) a negative wealth effect for investors and (2) an increase in the user cost of capital, that in the model determines housing and business investment. Therefore, the financial shock has only indirect effects on inflation through variations in aggregate demand.

Finally, the devaluation of the renmimbi has direct effects on foreign inflation by lowering the cost of non-commodity imports from China.[5] Similarly, joint devaluations in other Asian economies spill over through the same transmission channel, the size of such effect depending on the share of these countries in European and US non-commodity imports.

[4] During the late 90s and 2000s, some observers have expressed concerns about the growing centralization of the world's manufacturing production in Asia, particularly in China; the main issues for advanced economies, where a large fraction of Chinese exports is directed, were related to the implications for manufacturing employment and wages as well as to possible deflationary spillovers.

[5] Commodities are quoted in US dollars, so commodity import prices are not affected by exchange rate fluctuations.

3. A "hard landing" of the Chinese economy

3.1. Investment shock

In the past two decades the Chinese economy has acquired a primary role in the global economy. Since 1990, the country has experienced an average yearly growth rate of about 10%. However, in recent years the Chinese economy has lost some of its vitality. The country is undergoing a phase of transition from a growth model based on exports and investment in heavy industries to an economy more dependent on consumption and services. A shared view is that this is a welcome step towards a more sustainable development phase. However, the transition may be bumpy, especially given the imbalances accumulated in the recent years and the fears of a hard-landing, reinforced in some cases by the mudded policy responses of Chinese authorities and by doubts about the reliability of official statistics. This motivates the first step of our exercise, where we assume a slowdown in Chinese private investment that produces a reduction in GDP growth equal to 2 percentage points (p.p.) yearly for two years.

Results Table 1 (*left panel*) reports the results for inflation, in terms of deviations from the baseline. Inflation both in the euro area and the US is 0.1 p.p. lower than in the baseline in the first year of the shock and 0.4 p.p in the second. Trade is the main channel that explains the results. Lower growth in China lowers Chinese imports from the rest of the world. European and US exports fall by almost 2 p.p., reducing pressure on the respective aggregate demands and therefore on prices. Moreover, declining export prices in China translate into reduced imports cost. The lagged response on inflation results from the sticky price assumption incorporated throughout the model. It is also important to note that core euro area countries and peripheral ones respond in a similar manner.

Table 1 (*right panel*) reports the evolution of GDP. euro area output grows 0.3 p.p. less than in the baseline in the first year and 0.2 p.p less in the second. GDP growth in the US is 0.2 p.p lower than in the baseline in the first year, while it is unchanged in the second year due to a fast recovery of investment; private consumption is not significantly affected by the Chinese slowdown.

The Chinese investment shock has a stronger impact on the Asian trading partners of China, as Table 2 shows. Japan, South Korea, Indonesia and Hong Kong, the most affected countries, experience a significant fall in GDP. Part of the weak export performance in the euro area and the US stems from such third party effects, although the extent is limited.

3.2. Commodity price shock

In the NiGEM, commodity prices are not affected by variations in aggregate demand; therefore, our investment shock does not generate substantial variations in the price of commodities. However, it is reasonable to imagine that the Chinese investments slowdown might be accompanied with a fall in commodity prices. Indeed, China plays a very important role in commodity markets (e.g., Wang and Zhang, 2014). According to International Energy Agency data, China accounts for around 15% of global crude oil demand and about half of total demand for metals such as aluminum, copper, nickel and zinc. Given the strong weight of China on the global demand of commodities, there is little doubt that a slowdown in China, in particular if driven by investment, would affect oil and metal demand. Given the above mentioned limitation of the NiGEM, we impose an additional shock to the oil price (10 dollars decline) and to the metals price index (10% decline).

Results Table 3 (*left panel*) reports the effects on inflation in terms of the marginal contribution of the commodity price shock, to be added to the effects of the investment shock alone. Euro area and US inflation rates are around 0.5 percentage points lower than in the baseline in both years. The dynamics of inflation are comparable across the

Table 2
Asian GDP.

	Japan	South Korea	Hong Kong	Indonesia
1st year	−0.5	−0.7	−2.7	−0.6
2nd year	−0.5	−0.7	−0.7	−1.0

Table 2 reports the impact on Japan, South Korea, Hong Kong and Indonesia of the Chinese hard landing shock, in percentage points of deviation from the baseline GDP growth rate.

Table 3
Commodity prices shock: Inflation (*left panel*), GDP growth (*right panel*).

Inflation			GDP		
	EA	US		EA	US
1st year	−0.5	−0.6	1st year	0.2	0.3
2nd year	−0.4	−0.5	2nd year	0.2	0.4

Table 3 (*left panel*) reports the impact on euro area and US inflation of the commodities price shock, in percentage points of deviation from the baseline inflation rate. Table 3 (*right panel*) reports the impact on GDP growth, in percentage points of deviation from the baseline growth rate.

different countries composing the euro area, although the disinflationary effects are slightly more pronounced for the periphery. The main transmission channel operates directly through lower commodity import prices, which represent a considerable share of consumers expenditure. Moreover, lower commodity prices impact inflation also indirectly. As oil and metals are key input factors, a reduction in their price translates into a reduction in total production costs, contributing to lower final prices of manufacturing goods and services. Finally, there is a further indirect effect (a second-round effect) as the weaker inflationary path generated by the reduction in commodity prices through the two aforementioned channels alleviates the upward pressures on wages. However, this effect is not particularly significant, at least over the two-year horizon that we consider.

The commodity price shock, while beneficial in terms of GDP growth for most of the advanced economies (see Table 3, right panel), has detrimental effects on commodities-exporter countries.[6] The marginal effect on GDP growth in Russia, Africa and the Middle East is between 1 and 2 percentage points. While this could feed back to inflation in the euro area and the US through lower demand for their exports, these third-party negative trade spillovers are not particularly relevant; in any case, they are in part offset by the positive effects generated from other commodity-importers countries, which also benefit from lower commodity prices.

3.3. Financial shock

After years of sustained growth, in late 2015 and early 2016 Chinese financial markets experienced severe disruptions. European and US markets followed a similar pattern; stock prices fell and volatility and risk aversion indicators rose all over the world amid commentators worrying about global contagion from China. In this section we study the consequences of such financial turmoil on inflation in the euro area and in the US; our interest in financial spillovers is motivated by the strong linkages across international financial markets, as documented in Dua and Tuteja (2016). In order to reproduce the increase in uncertainty and volatility experienced by global financial markets, we shock risk premia and asset prices. In particular, we impose that equity risk premia rise by 50 basis points in China, Europe, US, Japan and United Kingdom and that asset prices in those same countries are 10% lower in both the first and second year after the shock.[7]

Table 4
Financial shock: Inflation (*left panel*), GDP growth (*right panel*).

Inflation			GDP		
	EA	US		EA	US
1st year	−0.1	−0.0	1st year	−0.1	−0.2
2nd year	−0.1	−0.2	2nd year	−0.2	−0.2

Table 4 (*left panel*) reports the marginal impact on euro area and US inflation of the financial shock, in percentage points of deviation from the baseline inflation rate. Table 4 (*right panel*) reports the marginal impact on euro area and US GDP growth of the financial shock, in percentage points of deviation from the baseline growth rate.

Results Table 4 *(left panel)* reports the marginal effect of the financial shock on inflation. In both countries, such marginal effect is negligible. The risk-premium rise translates into an increase in the user cost of capital; higher borrowing costs, together with the negative wealth effect of lower asset prices, reduce aggregate demand and put downward pressure on prices. Although the aforementioned channels play a role in the determination of inflation following a financial shock, they are not quantitatively relevant. The effects of the financial shock on GDP are reported in the right panel of Table 4. GDP falls on impact, due to the weaker dynamics of consumption and investment; consumption and investment fall because of the negative wealth effect of lower asset prices and higher borrowing costs, respectively. Overall, the financial shock does not produce significant effects on the real economy.

Summary

Table 5 reports the cumulative effects on inflation of the composite hard landing shock (the combined investment, commodity price and financial shocks), in case central banks do not respond. Two years after the shock, inflation is −0.9 p.p. lower than in the baseline in the euro area and −1.2 p.p. in the US.

4. Central bank reaction

In Section 3 we maintained the assumption that central banks in the four largest advanced economies (i.e., US, EA, JP, UK) do not take any conventional nor unconventional measure to counteract the negative spillovers coming from the Chinese shocks. We now construct alternative scenarios in which monetary policy actively responds. In particular, we impose that, instead of moving along the path forecasted in the baseline, the short-term interest rate in those countries follows a Taylor rule; in the case of the euro area, we also simulate the effects of an unconventional monetary policy reaction compressing the term spread on long-term interest rates. Our scenarios are the following:

1. US, UK, JP respond, EA does not.
2. All four CBs respond, EA with negative rates (as Japan).
3. US, UK, JP do not respond, EA responds with a QE.
4. All four CBs respond, EA with both negative rates and QE.

In order to evaluate the effectiveness of a monetary policy reaction in raising inflation, two factors must be taken into account: (i) the size

[6] GDP in the euro area grows 0.2 percentage points more in both years than in the case of the investment shock only. The effect on US is even more substantial, with US GDP growing 0.3 and 0.4 points more. As both the euro area and the US are net commodity-importers, lower commodities prices stimulate the economy through lower production costs, improving firms profitability and investments. Moreover, the lower commodities price increases real disposable income boasting private consumption.

[7] The equity risk premium enters both the equation of equity prices and the one of user cost of capital. However, a risk premium shock does not generate substantial movements in equity prices; therefore, in order to obtain substantial effects through both channels, we shock directly equity prices, too.

Table 5
Cumulative effect on EA inflation (*left panel*) and US inflation (*right panel*). No central banks intervention.

Euro area			United States		
	1st year	2nd year		1st year	2nd year
Investment shock	−0.1	−0.4	Investment shock	−0.1	−0.4
Commodities shock	−0.6	−0.8	Commodities shock	−0.7	−1.0
Financial shock	−0.7	−0.9	Financial shock	−0.7	−1.2

Table 5 reports the cumulative impact on euro area (*left panel*) and US inflation (*right panel*) of the different shocks, in the case central banks do not respond to the shock. Results are reported in percentage points of deviation from the baseline inflation rate.

and speed of the transmission to aggregate demand, which depends on the elasticity of consumption and investment to interest rates and on firms' price stickiness; (ii) the net exchange rate effects arising from the contemporaneous interest rate reactions in other countries.[8]

Results In the first scenario (*All respond but EA*), we consider the case in which central banks in the US, UK and Japan respond to the Chinese hard landing and the one in the euro area does not, as if the zero lower bound acted as a constraint for further conventional stimulus.[9]. Results are reported in Table 6.

The lack of reaction in the euro area magnifies the negative effects of the Chinese hard landing on domestic inflation; by contrast, the offset of the disinflationary spillovers in the US, UK and Japan is now stronger than in the previous case (see Table 8). This polarization is due to the appreciation of the euro vis-a-vis the other three currencies, that has opposite effects on imported inflation in the euro area with respect to that in the other three countries; in the euro area, the negative exchange rate effect on inflation adds to the lack of a stimulus to domestic demand.

In the second scenario (*All respond*), we re-run the hard landing shocks and we activate the Taylor rule also for the euro area, in addition to the US, UK and Japan. Results are displayed in Tables 7 and 8.

Table 7 reports variations in short-term rates as a reaction to the hard landing spillovers. The response is quite homogeneous across the four economies: −50 basis points in 2015, up to −90 in 2017, on average; this entails no significant exchange rate variations among them.While the speed of the transmission is diversified across countries, the effectiveness of the monetary policy reaction in terms of offsetting the disinflationary spillovers is almost the same by 2017, except for the UK where it is somewhat lower (see Table 8).[10]

In order to explore the unwinding effects on inflation of an unconventional monetary policy reaction in the euro area, we impose a negative shock to the term spread in all euro area countries and we disable the Taylor rule in the EA, US, UK and Japan (*Only QE in EA*). The shock is calibrated in such a way that the compression in long-term rates in all euro area countries is of 40 basis points on impact, based on the average results of Altavilla et al. (2015)[11]. Results are shown in Table 9.

[8] Concerning the second point, it is important to note that in Section 3, while any central bank reaction was muted for the euro area, United States, United Kingdom and Japan, it was allowed for all the other advanced and emerging economies. For this reason, our comments on the exchange rate effects will now be focused on the relative variations vis-a-vis the other three economies that are now allowed to react.

[9] On the contrary, Japan is instead allowed to set negative rates.

[10] Note that the NiGEM imposes a symmetric transmission mechanism of expansionary and contractionary monetary policy changes to prices. While in the proximity of the zero lower bound the effectiveness of monetary policy could be lower than in normal times, we interpret our results as an upper bound of the ability of central banks in reflating the economy.

[11] The authors estimate that the Asset Purchase Program announced in January 22, 2015 by the European Central Bank has reduced yields on 10-year sovereign bonds in the euro area by about 30-50 basis points on average

Table 6
All respond but EA: inflation, average p.p. deviations from the baseline.

	EA	US	UK	JP
1st year	−0.3	0.1	0.2	0.1
2nd year	−0.1	0.1	0.5	0.2

Table 6 reports the the gain (if positive) or loss (if negative) in inflation in case of a Taylor rule response in the United States, United Kingdom, Japan but not in the euro area. For the cumulated effect in the EA and the US, the elements of this table must be summed to the ones of Table 5.

Table 7
All respond: Short-term interest rate.

	EA	US	UK	JP
1st year	−0.5	−0.5	−0.6	−0.6
2nd year	−0.9	−0.9	−0.9	−1.0

Table 7 reports variations in short-term rates in advanced economies with Taylor rule on, percentage points difference from the baseline (annual averages).

Table 8
All respond: inflation, average p.p. deviations from the baseline.

	EA	US	UK	JP
1st year	0.1	−0.1	0.1	0.1
2nd year	0.2	0.1	0.3	0.2

Table 8 reports the gain (if positive) or loss (if negative) in inflation in case of a Taylor rule response in the euro area, United States, United Kingdom and Japan. For the cumulated effect in the EA and the US, the elements of this table must be summed to the ones of Table 5.

Table 9
Only QE in EA: inflation, average p.p. deviations from the baseline.

	EA	US	UK	JP
1st year	0.0	−0.1	0.0	0.0
2nd year	0.1	0.1	0.1	0.1

Table 6 reports the gain (if positive) or loss (if negative) in inflation in case of a 40 basis points compression in long-term rates in the euro area. For the cumulated effect in the EA and the US, the elements of this table must be summed to the ones of Table 5.

The effect on euro area inflation of a reduction in long-term rates is weaker than the one obtained with negative policy rates, because, in this case, only the interest rate channel of monetary policy is at play. Indeed, in the NiGEM, reductions in long rates via the term spread (and not via short-term rate variations) have no effects on the exchange rate, because the UIP involves short instead of long-term rates. The transmission to inflation is lagged: almost no effect in 2016, only 0.1 p.p. reduction in the disinflationary spillover in 2017.

In the last scenario, all the four central banks are allowed to respond via reduction in the short rate, and the term spreads in the euro area also shrink following an additional unconventional stimulus (*All respond + QE in EA*). Table 10. The overall effects in the euro area are those of reducing the disinflationary spillover by up to 0.4 p.p.

4.1. Summary for the euro area

Table 11 summarizes the results of the four scenarios presented in Section 4 for the euro area; the effects on inflation are cumulated with the overall spillovers coming from the composite hard landing scenario (*Investment+commodity+financial shock*). Cases (2) and (4) display the results of simulations in which all the four central banks respond. Considering only the first two years after the shock, the effectiveness of the monetary policy reaction in the euro area in terms of offsetting the disinflationary spillover is about a 30% offset in case (2) (i.e., −0.7 p.p.

Table 10
All respond + QE in EA: inflation, average p.p. deviations from the baseline.

	EA	US	UK	JP
1st year	0.2	−0.1	0.1	0.1
2nd year	0.4	0.1	0.3	0.2

Table 10 reports the gain (if positive) or loss (if negative) in inflation in case of a 40 basis points compression in long-term rates in the euro area. For the cumulated effect in the EA and the US, the elements of this table must be summed to the ones of Table 5.

Table 11
Cumulated effects on inflation when four CBs *do* respond.

Euro area		
	1st year	2nd year
Investment+commodity+financial shock	−0.7	−0.9
(1) All respond but EA	−1.0	−1.0
(2) All respond	−0.6	−0.7
(3) Only QE in EA	−0.7	−0.8
(4) All respond + QE in EA	−0.5	−0.5

from −0.9 p.p. in the second year), and 45% in case (4) (i.e., −0.5 p.p. from −0.9 p.p. in the second year).

5. Renminbi devaluation

Since the summer of 2015, the increasing pressure on the renminbi has forced the PBoC to engage in costly exchange market interventions, spending more than 600 billion USD in 2015 and reducing total available foreign reserves by 15%. In a hard landing scenario, a loss of confidence on the part of both international and domestic investors could trigger an acceleration of capital outflows. This could induce the PBoC to allow a more sizable, once-off devaluation to ease downward pressures on the exchange rate. On the one hand, this can help enhancing trade through exports (see, for instance, Bhattarai and Mallick (2013)); on the other hand, a renminbi devaluation might have a detrimental effect on domestic consumers through higher import prices, and more importantly on firms, which have largely financed their debts in foreign currency.[12] In this section we study the consequences of a 10% devaluation of the renminbi vis–vis the US dollar. Moreover, since recently the economic literature has highlighted the increasing role of the renminbi as a key driver for the exchange rate developments in the Asian economies (Ito, 2008, 2010; Fratzscher and Mehel, 2014), we further assume that the Asian countries most affected by Chinese developments (namely Hong Kong, South Korea, Taiwan and Indonesia), would also devalue their currencies (with respect to the US dollar) by the same amount.

Results Table 12 (*left panel*) shows that a 10% renminbi devaluation alone makes euro area inflation to fall by 0.2 p.p. in the first year of the shock and 0.3 p.p. in the second one. Inflation decreases because of the cheaper price of Chinese exports, once converted in euro. The effect is even larger for the US, where inflation falls by 0.4 p.p. each year, due to the higher weight of Chinese imports in the US consumption basket. The additional effect of the devaluation of the aforementioned Asian currencies is only weakly significant, see 12 (*right panel*). Concerning economic activity, GDP in the euro area and the US are not particularly affected either by the Chinese devaluation or by the Asian currencies devaluation (see Table 13).

[12] Moreover, a cheaper renminbi would probably slow down the transition of the Chinese economy towards a less export-oriented growth model.

Table 12
EA and US inflation. Renminbi (*left panel*) and Asian (*right panel*) devaluation.

Renminbi devaluation			Asian devaluation		
	EA	USA		EA	USA
1st year	−0.2	−0.4	1st year	−0.1	−0.1
2nd year	−0.3	−0.4	2nd year	−0.1	−0.1

Table 12 reports the marginal impact on euro area and US inflation of a 10% devaluation of the renminbi (*left panel*) and a 10% devaluation of the South Korean won, the Hong Kong dollar, Vietnamese dong and the Indonesian rupiah (*right panel*). Results on inflation are reported in percentage points of deviation from the baseline inflation rate.

Table 13
EA and US GDP growth. Renminbi (*left panel*) and Asian (*right panel*) devaluation.

Renminbi devaluation			Asian devaluation		
	EA	USA		EA	USA
1st year	−0.1	0	1st year	0.0	0
2nd year	−0.2	−0.1	2nd year	−0.1	0

Table 13 reports the marginal impact on euro area and US GDP growth of a 10% devaluation of the renminbi (left panel) and a 10% devaluation of the South Korean won, the Hong Kong dollar, Vietnamese dong and the Indonesian rupiah. Results are reported in percentage points of deviation from the baseline growth rate.

5.1. Summary

Table 14 reports the effects of the devaluation of the renmimbi and of other Asian currencies in case central banks do not respond. Results are cumulated to the composite hard landing shock. In the most extreme scenario with all five shocks combined (i.e., the hard landing scenario plus the two devaluation shocks), inflation would be up to 1.3 and 1.7 p.p. lower than the baseline in the euro area and the US, respectively.

Finally, Fig. 3 shows the impact of the five shocks on projected euro area inflation, assuming our baseline inflation is equal to the HICP forecasts provided by the European Central Bank in the March 2016 ECB staff projections. In the most pessimistic scenario, where the Chinese investment slowdown is associated to a fall in commodity prices, the financial market shock and the renminbi-Asian devaluation, inflation in the euro area would reach −1% in 2016 and would be just above zero in 2017 (compared to baseline projections of 0.1% and 1.3%, respectively).

Table 14
Cumulative effect on EA inflation (*upper panel*) and US inflation (*lower panel*). No central banks intervention.

Euro area		
	1st year	2nd year
Investment+commodity+financial shock	−0.7	−0.9
Renmimbi devaluation	−1.0	−1.2
Asian devaluation	−1.1	−1.3
United States		
	1st year	2nd year
Investment+commodity+ financial shock	−0.7	−1.2
Renminbi devaluation	−1	−1.6
Asian devaluation	−1.1	−1.7

Table 14 reports the impact on euro area (*left panel*) and US inflation (*right panel*) of the currency devaluations, in the case central banks do not respond to the shock. Results are cumulated with respect to the composite hard landing shock and are reported in percentage points of deviation from the baseline inflation rate.

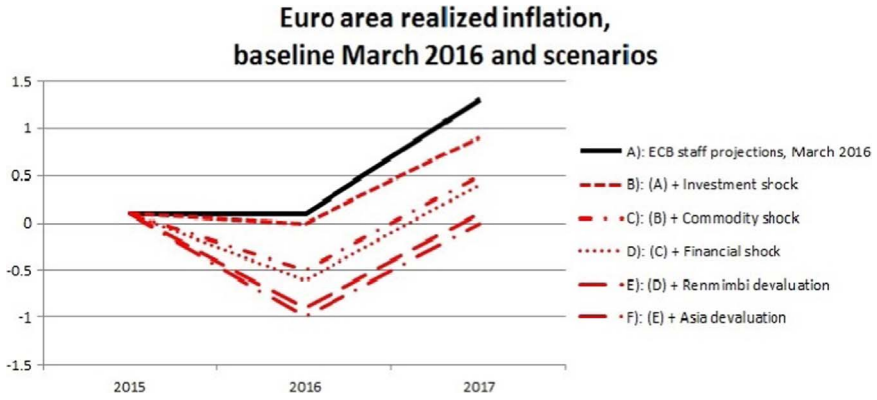

Fig. 3. Realized inflation, Fig. 3 reports the March 2016 ECB staff projections for the euro area HICP inflation and the alternative scenarios in deviation from that baseline.

6. Conclusions

The paper investigates, using the NiGEM model, the effects of a Chinese hard landing in the euro area and the United States. After constructing the hard landing scenario, we evaluate the quantitative spillovers arising from each shock, finding that significant disinflationary spillovers could be generated. In particular, absent any response from central banks, the Chinese investment slowdown alone can lower inflation by up to half a percentage point; if the slowdown is coupled with a fall in global commodity prices and a devaluation of the renmimbi, inflation in the euro area and in the US can drop by more than one percentage point below the baseline. Possible financial markets corrections associated with the Chinese slowdown do not significantly impact inflation. Finally, we study whether and by how much a central bank may reduce the fall of inflation following an external shock. We find that, depending on the type of policy tools used and on the concomitant monetary policy reaction in other countries, the central bank can undo up to around 40% of the reduction in inflation in the euro area. These results seem to be particularly relevant in light of the currently low inflationary environment.

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