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Costs and consequences of a trade war: a structural analysis

Antoine Berthou
Caroline Jardet
Daniele Siena
Urszula Szczerbowicz
Directorate General Economics
and International Relations

This Rue de la Banque *presents the findings of research carried out at the Banque de France. The views expressed in this post are those of the authors and do not necessarily reflect the position of the Banque de France. Any errors or omissions are the responsibility of the authors.*

Recent US policies (and announcements) and consequent retaliations have increased the threat of a global trade war. This Rue de la Banque *provides an assessment of the global macroeconomic short-term implications of higher trade tariffs for the global economy using the International Monetary Fund (IMF) global integrated monetary and fiscal model (GIMF). This quantification takes into account the direct (increase in trade tariffs) and indirect (fall in productivity, rise in financing costs and increase in uncertainty) channels of a global trade war. A global and generalised 10 percentage points (pp) increase in tariffs could reduce the level of global gross domestic product (GDP) by almost 2.0% on impact, and up to 3.0% after two years.*

Since the beginning of 2018, the US administration has announced and implemented a series of protectionist measures for products such as steel and aluminium. While the overall volume of trade covered so far remains limited (in September 2018, new import tariffs implemented by the United States (US), China, Canada, Mexico and the European Union (EU) accounted for about 3% of global imports), additional measures could be considered by governments. Following China's decision to retaliate against US tariffs on Chinese goods, the White House announced additional tariffs during the summer covering USD 200 billion of imports from China. These additional measures were implemented in September 2018, but ultimately, all of US imports from China could be potentially targeted by new tariffs.

New protectionist measures could also be extended by the US administration to imports of automobiles and auto parts, raising the risk of a geographical spread of the trade war as the regions mostly affected could also retaliate.

The long-term cost of a trade war: lessons from the literature

The general perception of economists on trade wars is that they are not easy to win, even for large countries such as the United States (see the Banque de France blog post by Berthou et al. 2018). Unilateral protectionist measures are often subject to retaliation by trade partners, as recently observed following the rise of US tariffs. However, the economic consequences of these trade policies are difficult to forecast and quantify. This explains why different methods might be appropriate to assess long- and short-run effects of a global trade war.

General equilibrium quantitative trade models can be used to simulate the long-term effects of trade wars. The results obtained from these models have been summarised in a recent blog post in the New York Times by Paul Krugman: a generalised tariff increase of between 30 and 60 percentage points (pp) would lead to a global real GDP loss of 2% to 3% over the long term.

Similar figures are provided in a recent note published by the French Council of Economic Analysis (CAE), which states that a 60 pp increase in import tariffs would result in a 3% to 4% decline in real GDP in large economies in the long run. This relatively low impact, even for a very large increase in tariffs with respect to historical standards, is explained by the moderate trade openness, even including trade in services, of major economies such as the United States (27%) or the European Union (35% excluding intra-EU trade).[1]

International macroeconomic models are instead often used to quantify short-term effects. The more detailed description of short-term dynamics, due to the inclusion of frictions in different markets (financial, labour or goods markets) and the presence of endogenous policy responses (monetary and fiscal policy) allow for a more accurate quantification of the dynamic effects of protectionism in the short- or medium-run.[2]

In this *Rue de la Banque*, we use an international macroeconomic model to assess the short-term effects of a global trade war. Our analysis is based on simulations using a multi-region, forward-looking dynamic stochastic general equilibrium (DSGE) model: the global integrated monetary and fiscal model (GIMF).[3]

GIMF is an open economy, multi-region, multiple intermediate and final goods, forward-looking and fully micro-founded DSGE model. The economies considered are characterised by sticky prices and wages, real adjustment costs and non-Ricardian households. The model explicitly accounts for all the bilateral trade flows and tracks relative price dynamics for each region, such as bilateral and effective exchange rates. The model is calibrated at a yearly frequency for three regions of the world: United States (US), euro area (EA) and remaining countries (RC).[4]

The short-term direct *effect of a 10 pp increase in trade tariffs*

In our simulation we analyse a full trade war scenario. That is a *permanent* 10 pp increase in tariffs on imports of both intermediate and final goods from all the trading partners in all the three regions of the world – US, EA and RC. While this scenario is not necessarily the most likely, it highlights the (presumably) large real costs of a generalised global trade war.[5]

In the short run, higher import tariffs result in an increase in the price of imported goods in all regions. This increases the cost of imported intermediate inputs for firms and therefore contributes to raising their production costs. Consumers also face higher prices for imported consumption goods. Given the imperfect substitutability between domestic and foreign varieties, and frictions on the supply side faced by domestic producers, consumer prices increase. The negative impact on consumption is however mitigated by the tariff receipts of the government, which we assume are transferred to households.

In addition, these effects are amplified by monetary policy responses, the global nature of trade wars and the permanent nature of the tariffs. In response to inflationary pressures (i), central banks tighten monetary policy, which increases the real interest rate. This pushes down firms' demand for capital, and reduces investment and consumption. In addition to the fall in aggregate domestic demand (ii), retaliation from other countries implies that the demand for domestic exports from foreign countries also declines. Finally (iii), the permanent nature of the increase in tariffs reduces not only current but also future foreign demand, pushing down investment even further.

All in all, the simulations of the model conclude that the global increase in tariffs associated with a trade war would reduce real GDP in all regions. According to our baseline simulation, global GDP is likely to fall by 0.7% in the first year and up to 1.1% at the end of the third year following the shock. The impact on inflation is ambiguous as the direct inflationary impact of higher tariffs is mitigated by monetary policy responses and by the fall in demand (domestic and external) which puts downward pressure on prices. According to the simulation, the global increase in inflation would be moderate and short-lived (0.1 pp globally after one year, 0.04 pp after three years).[6]

1 *Trade in goods and services (% of GDP) as reported by the European Commission (2018, p. 22).*
2 *Whether these models lead to larger or smaller losses in the short and medium term compared with the long-term horizon of general equilibrium quantitative trade models is an open question.*
3 *See Anderson et al. (2013) – the IMF Working paper No. 13/55 – for a complete description of the model and the monetary policy rule for each region.*
4 *For alternative analyses conducted with GIMF model but based on limited trade war scenario see ECB Economic Bulletin, No. 6, 2018 and IMF WEO October 2018, Chapter 1.*
5 *During the Great Depression in the 1930s, average trade-weighted import tariffs were raised from about 10% to 20%, with much larger increases in continental Europe than in North America (see Table 2, Crucini and Kahn, 1996).*
6 *According to our simulations, global inflation would increase by 0.18 pp, 0.21 pp and 0.14 pp after one, two and three years respectively, were the policy rate to remain fixed for two years. Global GDP would diminish by 0.4%, 0.7% and 0.9% in the absence of a monetary policy response for two years.*

Importantly, in GIMF, the "remaining countries" (RC) region is considered to be a single large economy. So, the simulation does not account for the possibility of a generalised global trade war within this bloc (e.g. between Korea and China). For this reason, and because the RC region is calibrated to be less opened to trade compared to individual economies composing this bloc (e.g. 30% for China; 70% for Korea), the trade impact of our simulation tends to under-estimate the direct impact of a generalised global trade war.

Still, the simulation of a generalised global trade war with three large regions in GIMF provides reasonable, but larger numbers when compared to the long-run effects of the quantitative trade models mentioned above.[7]

The short-term indirect *effects*

In addition to the direct channel of a tariff increase, a trade war can also impact economies through additional indirect channels:

1. a fall in productivity, as a result of an inefficient reallocation of factors of production across firms (indirect effect 1);

2. a rise in the financing cost of capital due to an increase in actual or perceived borrower risk (indirect effect 2);

3. an increase in uncertainty on future business conditions resulting in a decline in investment demand, caused by firms' "wait and see" attitude (indirect effect 3).

These indirect channels could amplify the direct effect of a tariff increase. In particular, effects 2 and 3 are consequences of the rise in uncertainty triggered by the trade war, based on the hypothesis that protectionism (even if it does not materialise) would trigger financial stress.

In what follows, we provide an assessment of these indirect effects by calibrating shocks in the model.

Indirect effect 1: decrease in productivity

The baseline GIMF model misses some of the transmission channels that are now often introduced in international trade and international macro models, such as the role of heterogeneity within sectors across firms. Yet, a trade shock can affect aggregate productivity by changing the allocation of productive resources across heterogeneous firms, as shown by heterogeneous firms trade (HFT) models (see Burstein and Melitz , 2003), or in open economy macroeconomic models with heterogeneous firms (see Ghironi and Melitz, 2005).[8] In trade models, these selection and reallocation effects are observed at the steady-state, i.e. in the long-run. However, they may also operate in the short and medium run (see Melitz, 2013) as firms modify their entry decisions when they face for instance higher trade costs, or may lose market shares to the detriment of less productive firms. The main result of this class of models is that higher trade costs tend to protect low productive firms from foreign competition, and favour the reallocation of productive resources from high to low productive firms, thereby reducing aggregate total factor productivity.

We assess this amplification effect in GIMF by applying a negative shock to the productivity of the tradable sector in all three regions. The calibration of this productivity shock is based on Berthou et al. (2018). A 10 pp tariff increase is expected to generate a permanent **decrease of 1.75% in total factor productivity**.

In our simulation, the calibrated shock on productivity (taken in isolation) has an impact on global real GDP of close to –0.2% on impact, and reaching –0.5% after 3 years. The impact on global inflation remains small, at close to zero.

Indirect effect 2: more stringent financing conditions

As protectionism increases the production cost of domestic firms and reduces their foreign demand, the financial sector may start demanding a higher premium on corporate lending.

Indeed, in the light of recent experience, we see that US corporate spreads have increased significantly since February 2018, as Donald Trump started to announce a series of trade policy measures on solar panels and

7 *Indeed, in our framework, a simulation of a 60 pp increase in import tariffs would cause a 6% loss in global GDP.*

8 *Note that productivity could also be affected by trade shocks due to the reallocation of resources across sectors (comparative advantage). Within sectors, Aghion et al. (2018) show that trade shocks can affect the innovation of firms. Our quantification does not take account of these channels due to modelling constraints of the GIMF model (there is only one sector of final goods).*

washing machines, followed by steel and aluminium tariff announcements in March. This increased the external borrowing cost of non-financial firms. In order to evaluate this channel, we assume that firms are subject to an increase in their riskiness that generates an **increase in the borrowing risk premium of between 50 basis points (bp) and 100 bp.** 50 bp is indeed the one standard deviation of the long-term corporate spreads in the United States between 1985 and 2017, whereas 100 bp corresponds to two standard deviations. We present two scenarios: in the first one ("low uncertainty increase"), the corporate rate spread rises by one standard deviation; in the second ("high uncertainty increase"), the shock is of two standard deviations, therefore similar in size to the latest global financial crisis. In both cases we assume that the borrowing cost increases in all areas: US, EA and RC.

As the cost of financing increases, business investment falls. Lower investment reduces the capital stock and the demand for labour driving down wages. Reduced household labour income lowers consumption and inflation. The monetary authority responds to this fall in inflation by lowering the policy rate. As a result, the response of inflation is muted, with a fall of 0.05 pp ("low uncertainty increase") to 0.1 pp ("high uncertainty increase) on impact, and a decline of 0.1 pp to 0.2 pp after three years.

Overall, global real GDP declines by 0.4% ("low uncertainty increase") to –0.7% ("high uncertainty increase) on impact and by 0.3% to 0.5% after three years. The negative effect is mostly caused by the fall in investment.

Indirect effect 3: increase in uncertainty about future business conditions

An increase in uncertainty about demand or the implementation of economic policies could make firms call into question or put off their investment choices, adopting a wait-and-see attitude. In a more uncertain environment, firms put on hold their investment plans as it allows them to gather more information about their future profitability; uncertainty therefore weighs on the macroeconomic dynamics of investment.

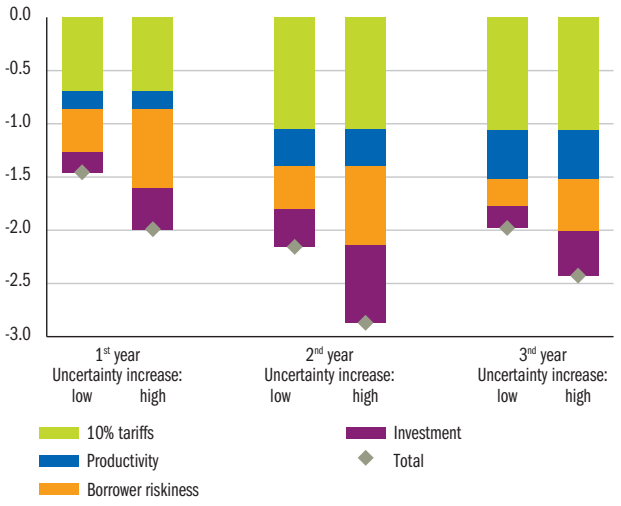
We quantify this effect by applying a negative shock on investment demand in the three regions. The size of this shock is the same for the US, the EU and the RC, and is calibrated to produce a decrease in investment consistent with elasticities found in the literature on uncertainty (Bussière, Ferrara and Milovich, 2015). More precisely, this **shock implies a fall in investment equal to approximatively 1.4% to 2.8% after two years** (this corresponds to a positive shock of respectively one and two standard deviations in uncertainty, proxied by the volatility index VIX).[9]

Taken in isolation, these shocks decrease global real GDP by approximately 0.2% ("low uncertainty increase") to 0.4% ("high uncertainty increase") on impact. The impact after three years is of the same magnitude, while the maximum decrease in real GDP is reached after two years (0.4% to 0.7%). The impact on global inflation remains limited (–0.1 to –0.15pp after three years).

The overall effect

The direct tariff shock and the three indirect effects are simulated separately in the model in order to quantify the relative contribution of each channel (see Charts 1 and 2). The combined (direct + indirect) impact is obtained by adding all these contributions.[10]

C1 Impact on global GDP
(in deviation of the baseline, %)



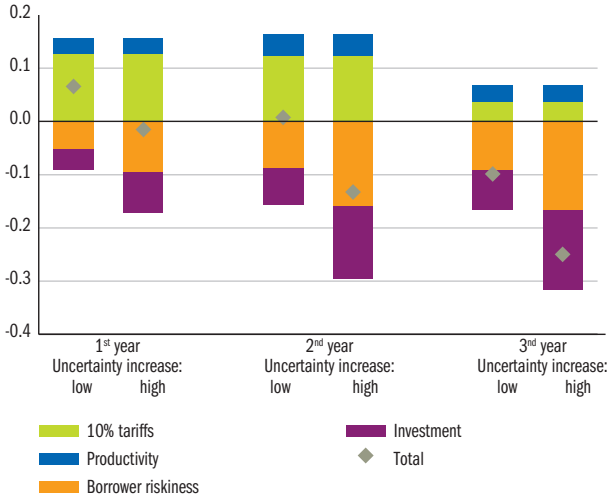
Source: Authors' calculation.
Note: Effects of corresponding shocks taken in isolation obtained from simulations of GIMF. "Low" effect corresponds to a shock of one standard deviation on the borrower riskiness and on uncertainty affecting investment. "High" effect corresponds to a two standard deviation of these shocks. The direct trade effect is unchanged.

9 This measure seems to be a good proxy of uncertainty that emerged around the date of announcement of tariff increases.

10 The full impact of the generalised global trade war on output and inflation is similar if we add separately these individual contributions or if all shocks are introduced simultaneously into the same simulation of the model.

C2 Impact on global inflation

(in deviation of the baseline, pp)



Source: Authors' calculation.
Note: See Chart 1.

Moreover, the increase in uncertainty is assumed to be "low" or "high" depending on the magnitude of the shock on the bond risk premium and the VIX (50 to 100 basis point rise in the risk premium and one to two standard deviations increase in the VIX).

Accounting for all channels (direct + indirect), and taking the upper bound of these indirect channels ("high uncertainty" scenario), a generalised global trade war triggering high financial stress could reduce the level of global GDP by up to 2.0% on impact, and by up to 3.0% after two years.

Conclusion

While the most extreme scenario is not necessarily the most likely, this *Rue de la Banque* highlights the potentially large real costs of a trade war generating high financial stress. We show that in a multi-country DSGE model such as GIMF, the global real GDP losses from a generalised increase in tariffs of 10 pp are significant in the first two years following the start of the trade dispute, and may be amplified via the indirect effects of the trade war on productivity and uncertainty.

A take-away of this simulation is that a collapse of the global trading system – i.e. a weakening of the position of the World Trade Organization as the supervisor of fair and transparent trade practices between its members – could not only reduce global welfare in the long run, but would also be a drag on global GDP growth in the short term.

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