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Innocent bystanders: How foreign uncertainty shocks harm exporters

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Summary
The failure of trade economists to anticipate the extreme drop in trade post-Lehman Brothers bankruptcy suggests that the behaviour of trade in exceptional circumstances may still be poorly understood. In this paper we explore whether uncertainty shocks have explanatory power for movements in trade. Our VAR estimations on US data suggest that domestic uncertainty is a strong predictor of movements in imports, but has little effect on exports. Guided by these results, we estimate a bilateral model with focus on the impact of importer uncertainty on foreign suppliers. We find that there is a strong negative relationship between uncertainty and trade and that this relationship is non-linear. Uncertainty matters most when its levels are exceptionally high. We find no evidence of learning from past turmoils, suggesting that prior experience with major uncertainty shocks does not reduce the effect on trade. In line with our expectations, the negative effect of uncertainty shocks on trade is higher for trade relationships more intensive in durable goods. Surprisingly, however, the effect of durability is non-linear. Supply chain considerations or the possibility that the relationships with the highest durability lead to important compositional effects may have a bearing on the results. Our results are robust to excluding the post-Lehman shock, suggesting that the trade response during the 2008-09 crisis has been similar to past uncertainty events.

Keywords: uncertainty, international trade.

JEL Classification: F02, F10, G01.

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1 Introduction

The exceptional features of the 2008-09 trade crisis were largely unanticipated by trade economists.[1] Simulations which focused on the 2008–2009 trade crisis, aimed at identifying the contribution of demand and that controlled for international input-output relationships, have hardly reproduced the magnitude of the slump in world exports (Benassy-Quere et al., 2009; Willenbockel and Robinson, 2009). Similarly, standard trade forecasting models, which only account for "real-economy" mechanisms, show a sudden increase in the unexplained residual in coincidence with the recent crisis (Cheung and Guichard, 2009; Levchenko et al., 2010).[2]

The failure of traditional models to account for these developments suggests that the behaviour of trade in exceptional circumstances may still be poorly understood. Some economists have proposed new structural measures of aggregate demand for empirical trade equations (Bussiere et al., 2011). The current paper, instead, investigates how uncertainty and confidence factors affect international trade. Understanding this nexus may contribute to shed light on some of the potentially harmful effects of globalisation (Rodrik, 1997, 2011). In particular, we argue that while international trade developments are usually well explained by demand and cross-country differences in competitiveness, under exceptional circumstances confidence factors may also have a large impact on trade flows. This is consistent with the real-business cycle literature according to which a temporary increase in uncertainty can have non-negligible effects on aggregate activity.

Why can one expect extreme movement and unusually high variability in financial markets to generate temporary uncertainty about future incomes, even among people that do not hold finan-

[1] In the last quarter of 2008 and in the first quarter of 2009 trade contracted in an exceptionally sudden, severe and globally synchronised fashion. This great trade collapse was unparalleled in its suddenness: the decline of world trade totalled, in value, 29 per cent in just four months, from September 2008 to January 2009. It was also seemingly out of line with the decline of world GDP, which contracted by less than 3 per cent over the same period.

[2] The two main determinants of a country's exports accounted by forecasting models are foreign demand and its competitiveness position relative to other countries competing on foreign markets. Foreign demand is usually computed as a weighted average of the import volumes of trading partners. Export competitiveness is measured as the relative price between domestic prices and foreign prices, both measured in a common currency. Similarly, the two main determinants of a country's imports accounted for by forecasting models are domestic expenditure and its price-competitiveness relative to other countries competing on the domestic market. In both cases, under normal conditions empirical estimates attribute to demand about 70-75 per cent of the overall trade changes and to relative prices another 20-25 per cent. In such specifications, purely based on production and demand forces, exchange rate developments enter as a component of relative prices. Financial conditions, on their part, enter the function indirectly as a "structural" element that contributes to explain countries' trade potential and geographical orientation. Uncertainty has no explicit role and enters, at best, through fluctuations in demand.

cial assets? Financial markets can be considered an imperfect but readily available predictor of the real economy. Hence, it is likely that consumers and producers alike associate unusual developments in financial markets with greater uncertainty as to the future of the economy. Casual observation suggests indeed that confidence and credit crises are likely to happen jointly, as they rely on the same collective predictions as to the state of the economy. After all, their Latin roots indicate that they reflect similar sentiments: the word "confidence" comes from the Latin *fido,* which means "I trust, I believe" while the word "credit" comes from the latin *credo* which also means "I trust, I believe".

To date, the analysis of the effects of uncertainty on trade remains largely confined to exchange rate volatility, where studies broadly find that the effect of exchange rate volatility on aggregate trade flows is "fairly small and by no means robust" (IMF, 2004). Yet, a crisis of confidence may easily curtail international trade, as investment and consumption decisions are put on hold. Investment and consumption as well as money markets and banks' willingness and capacity to lend have been shown to be reduced in the presence of a crisis of confidence. For example, during the Great Depression uncertainty played a role in the initial 1929-1930 slump, which was propagated – also internationally – by the 1931 banking collapse (Romer, 1990).The temporary increase in uncertainty caused also an immediate drop in investment spending, as discussed in Bernanke (1983). Indeed, while total factor productivity fell by 18 per cent between 1929 and 1933 (Ohanian, 2002), output did not shift to low-cost firms (Bresnahan and Raff, 1991), as it may have done if only real-economy mechanisms were at play.

In this paper we assess the importance of exceptional systemic uncertainty in explaining trade developments during and after a major shock. We believe that such question is very relevant to understanding recent trade developments. Bloom (2009) shows that uncertainty tends to increase dramatically after major economic or political shocks. There is consensus that the global crisis represents indeed a major economic shock likely to have generated large negative confidence effects.[3]

[3]The "Subprime Crisis" broke out in August 2007 and for over one year it was broadly viewed as a financial crisis restricted mainly to those few industrialised countries with financial markets developed enough to absorb large quantities of the sophisticated financial derivatives, which were at the origin of the crisis. The metastasis into the "Great Global Recession" took place in September 2008, when a rapid sequence of extreme events plunged the world into "Knightian uncertainty", or fear of the unknown (Blanchard, 2009; Caballero, 2009a,b). Consumers, firms, and investors around the world applied a strategy of "wait and see" by delaying investment and purchases of

To the best of our knowledge, this is the first paper that tackles explicitly the behaviour of trade in response to exceptionally high systemic uncertainty. We use a stock market volatility measure as a proxy for uncertainty, following a common practice in the uncertainty literature. Even though past literature has not been concerned with the impact of uncertainty on international trade, a lot has been written about its impact on producer and consumer behaviour. Both strands of the uncertainty literature (that is, the one addressing producer behaviour and the one on consumer behaviour) imply that, under uncertainty, economic agents freeze their activity and postpone decisions on purchases. This is the case, in particular, for those goods whose purchase is partially or totally irreversible for long periods of time. Capital goods, acquired by producers, and durable goods, acquired by consumers, fall into the category of goods whose purchase decision is likely to be postponed. The inaction persists until uncertainty subsides and it gives rise to pent-up demand in the medium term, so that after a period of uncertainty there might be an overshooting effect. This is indeed what happened in late 2008 and early 2009. After an extreme drop, for some countries representing as much as 30 per cent of their total value of exports, trade returned on a relatively strong path to recovery.

We investigate the uncertainty hypothesis first by means of a vector autoregression model in an analysis very similar to Bloom (2009). However, we expand his analysis, which is entirely focused on producer behaviour, in two respects. First, we address consumer uncertainty and, second, we apply the framework to a setting of international trade. In contrast, Bloom models and simulates the joint effects of time-varying uncertainty on labour and capital investment for the firm, abstracting from any international dimension. Our results show that uncertainty disproportionately affects imports. Our next step is therefore to analyse empirically the effect of importer uncertainty on exports. We do so using a dataset of bilateral trade between 32 developed and developing countries. We find that elevated uncertainty has significant negative effects on trade even when controlling for potentially confounding factors such as financial constraints and reductions in wealth, which tend to accompany major uncertainty periods. We find evidence that non-durable goods are not affected by uncertainty. The negative effect of uncertainty on trade is generated however not by bilateral trade relationships most intensive in durable goods

all what could be postponed. Investors switched their wealth to the safest assets, causing what Caballero has called a "sudden financial arrest", leading to deleveraging and a retrenchment of investment, often towards domestic assets (Kamil and Rai, 2009). In 2012 the crisis is still ongoing with the economic side effects of the European sovereign debt crisis, accompanied by slow US and Chinese growth.

but by those with a relatively balanced mix of durable and non-durable trade. Supply chain considerations or the possibility that the relationships with the highest durability lead to important compositional effects may have a bearing on the results. This finding calls for additional research on the linkages between durability, uncertainty and trade. Lack of intra-annual bilateral data by product category however does not allow to identify better the role played by durability. We also show that prior experience with major uncertainty shocks does not reduce the effect on trade, that is, we do not find evidence of learning from prior shocks that would help smooth out the adverse impact. Finally, the response of trade to uncertainty in the 2008–09 crisis reflected the behaviour of trade in past confidence crises. The difference was in the size of the drop and subsequent recovery which was much stronger in the most recent crisis compared with the past.

The rest of the paper is organised as follows. Section 2 reviews the insights from the theory and discusses the predictions for the impact of uncertainty on aggregate trade. Section 3 provides a preliminary empirical analysis using the United States data. Section 4 discusses our methodology and data. Section 5 brings the empirical investigation to an international setting. By means of a dynamic bilateral model it investigates the impact of exceptional uncertainty on imports and tests the main predictions outlined in Section 2. Finally, Section 6 concludes and draws the implications of our results.

2 Producer and consumer uncertainty

The fact that a temporary increase in uncertainty can cause an immediate drop in investment is discussed in Bernanke (1983) and extended to the effects of income uncertainty on consumer spending by Romer (1990). At the same time, Dixit (1989a) shows that, in making entry and exit decisions, uncertainty about future prices creates an option value of waiting until more information about the state of the world is received. The generality of the idea is perfected and shown to have many applications in Dixit and Pindyck (1994). Building on a body of literature that became very rich in the past two decades, a recent paper (Bloom, 2009) provides a structural framework to analyse the effect of uncertainty shocks jointly on investment and hiring. In the following sections we will summarise the key concepts from this body of research and explain how this applies to international trade.

2.1 Producer uncertainty

Bernanke (1983) discusses how an increase in the cost of credit intermediation can account for the link between uncertainty and investment spending. Later research (Dixit, 1989a; Dixit and Pindyck, 1994) emphasises that the changes in investment spending are the outcome of decisions that are very often made in an uncertain environment and are costly to reverse later. More precisely, for producers facing increasing returns, the relative payoff to various investment projects will depend on the uncertain level of future income. Besides being subject to some degree of uncertainty over the future rewards, most investment decisions share two additional important characteristics. First, there is some leeway about the timing of the investment, that is, the investor can postpone action to get more information about the future. Second, investment decisions are subject to non-negligible adjustment costs. The latter can be convex or non-convex.[4]

[4] While early studies on investment mainly discussed convex adjustment costs, that is, those whose marginal cost is increasing in the rate of investment, more recently the literature on investment and employment adjustment costs typically focuses on three types of non-convex costs: irreversibilities, fixed disruption costs and quadratic adjustment costs. Irreversibilities indicate that labour and capital investment are totally or partially irreversible. Labour partial irreversibilities are, for example, the per capita hiring, training and firing costs while examples of capital partial irreversibilities are instead the resale losses due to non-recoverable transaction costs, the market for lemons phenomenon, and the physical cost of resale. Fixed disruption costs, on their part, arise when a loss of output is generated due to the need to integrate new workers into the production process or to install new capital. Finally, quadratic adjustment costs are related to the rate of adjustment due to higher costs for more rapid changes.

The above characteristics interact to determine the optimal decisions of investors. For the firm, the optimisation problem becomes one of maximising the present discounted flow of net revenues while also accounting for the non-convex adjustment costs and for the non-linear nature of investment and hiring decisions. It follows that a wait-and-see attitude in investment and hiring may be a rational decision under certain circumstances. Firms only hire and invest when business conditions are sufficiently good, and only fire and disinvest when business conditions are sufficiently poor. When uncertainty increases, firms become more cautious in responding to business and macroeconomic conditions. It follows that producers have an option value of waiting. The existence of values for which the real option value of waiting is worth more than the returns to investment, disinvestment, hiring or firing gives rise to a region of inaction. Only outside the region of inaction decisions are governed by the discounted value of the respective marginal returns.

The generality of the idea and the variety of its application is brought out by Dixit (1989a) and the joint effects of time-varying uncertainty on labour and capital investment for the firm are modelled and simulated by Bloom (2009). All in all, one can expect that the option value of waiting for producers is increasing in uncertainty and in the amount of implied non-convex adjustment costs.

2.2 Consumer uncertainty

While the more recent literature has mainly analysed the reaction of firms to uncertainty, there is a substantial body of literature showing that uncertainty also has strong effects on consumer behaviour. Dixit (1989a) and Romer (1990) among others point out that the intuition of why uncertainty might depress investment spending can straightforwardly be applied to consumer spending. Under uncertainty, consumers might find it advantageous to delay the purchase of goods, in particular those whose purchase is partially or totally irreversible for long periods of time, that is, durable goods. More precisely, not knowing the value of their future income, consumers may choose a consumption bundle that is either too luxurious or too modest relative to their future level of income. On the other hand, if they wait, they will be very far from the optimal level of consumption while waiting but then, as soon as the uncertainty about future income is resolved, they will be able to choose the appropriate level of consumption. Hence, one can expect that, intertemporally, the option value of waiting for consumers is increasing in the weight of durable goods in the consumer expenditure function and it is also higher the longer the irreversibility of their purchase.

The adjustment mechanism that governs the purchases of consumption goods is critical for understanding why durables consumption in particular will overreact under uncertainty. In early work on this topic Bernanke (1984, 1985) uses a rule that implies a regular adjustment with which the consumers close the gap between their desired and actual levels of durables stock. However, this type of behaviour is not consistent with the data in which adjustments happen only infrequently. This observation has led subsequent studies to address the shortcoming of Bernanke by modelling the adjustment mechanism via the (S,s) model framework first used by Arrow et al. (1951) in the context of inventories adjustment, for example Lam (1991); Attanasio (2000); Eberly (1994); Bertola et al. (2005). In the standard textbook (S,s) model, inventories are allowed to vary between two target levels of stock, the upper, S, and the lower, s. Applied to consumer spending, the upper band S and the lower band s refer to the maximum and minimum stock of consumption goods a household desires to hold relative to their income. The consumer increases spending when stocks fall to the lower target level and reduces it when they reach the upper level. In this framework, the existence of transaction costs associated with purchases of durables leads to an irregular adjustment particularly for this category of goods.

Lam (1991) considers a situation when the consumer uses a threshold criterion instead of adjusting the stock regularly in small increments to close the gap between desired and actual level of durables. In his model the consumers buy or sell durables when the stock exceeds a certain lower or upper threshold, but do not act otherwise. He shows that households adjust stocks infrequently and expenditures react more to large income shocks than to small shocks. Furthermore, desired stocks are not very sensitive to transitory income, upward adjustments happen quicker than downward adjustments and thresholds levels vary across households. He attributes the different speed of adjustment to imperfections in resale markets while the threshold heterogeneity across households is a consequence of liquidity constraints. When households are faced with a lack of access to credit or excessively expensive finance, the upper threshold level increases as they are unable to adjust their durables stock to the desired higher level. The low threshold on the other hand will be small because if the desired stock is lower than the actual stock, households might be tempted to resell their durables in order to be able to purchase the non-durables they cannot access due to credit constraints.

Attanasio (2000) provides additional insights into the relationship of the adjustment bands and consumer income. He models the purchases of cars by US households as an (S,s) rule defining his thresholds in terms of the ratio of durables to non-durables. Using a large microeconomic dataset he directly estimates the (S,s) parameters and finds that desired ratio of durables is lower for households with lower incomes. In addition, he also find evidence that the (S,s) bands are large. This implies pervasive inertial behaviour and potentially high relevance for the determination of aggregate expenditure. Unfortunately, as shown by the paper itself, explicitly deriving aggregate implications proves difficult.

Such aggregate implications are attempted in Eberly (1994). Similarly to Attanasio (2000), this paper tests for (S,s) bands behaviour under uncertainty using data at the level of the individual household. Based on Grossman and Laroque (1990), her (S,s) model assumes that households adjust their stock of durables to a desired share of wealth. Once this level of durables to wealth stock is achieved, households allow it to depreciate until it reaches a critical lower bound level. At this point they purchase a new durable. She distinguishes between liquidity constrained and non-liquidity constrained households and focuses only on those households facing an adjustment cost. She finds strong evidence for the (S,s) type adjustment which she also expects to translate to the aggregate level. However, according to Foote et al. (2000), the (S,s) type adjustment model has very little to tell at aggregate level, because any discrete adjustments will be smoothed out due to the presence of agent heterogeneity.

Like previous studies, Bertola et al. (2005) also attempt to derive aggregate implications from effects observed at the micro-level and indeed find that the negative effects of uncertainty on individual households translates into a negative aggregate effect. Specifically, they assess the effect of uncertainty on the frequency and size of adjustments for three different types of durable goods: vehicles, furniture, and jewellery. They show that small adjustment costs can imply wide ranges of inaction under uncertainty. Higher uncertainty widens the range of inaction and a more uncertain future leads to a lower probability of adjustment, but the adjustment is larger if it does occur. They find evidence that lump-sum adjustment costs are the predominant source of inaction in their dataset. Most of their results only hold for the vehicles, most likely because the other two categories are less subject to adjustment costs.

Other studies have instead focused on the impact of uncertainty on consumer behaviour specifically during downturn periods. In a study closely related to this one, Romer (1990) looks for evidence of the uncertainty hypothesis in the 1930s recession, using data for the United States. The paper assumes the existence of an inverse relationship between consumer spending on durable goods and uncertainty about future income. The paper also suggests that one should expect a positive wealth effect on non-durable goods: consumers who are not buying durable goods will have more wealth to spend on perishable goods. She establishes that uncertainty is a positive function of stock market volatility. On this basis, stock market volatility and consumer spending on durables should be negatively related. The choice of a stock market volatility measure as a proxy of uncertainty opens, however, the possibility for alternative explanations. Therefore, she also explores alternative sources of the nexus between stock market volatility and spending on durables, namely first order stock market adjustment and financial constraints. However, even controlling for those effects, the uncertainty hypothesis remains valid. Carroll and Dunn (1997) analyse the recession of 1990s that was characterised by a spontaneous decline in consumption, particularly in durables. The recession came after a period of strong build-up of household debt, in part driven by high spending on durable goods, which leads them to explore the link between uncertainty and balance sheet deterioration. They find that unemployment expectations influence spending beyond any information those expectations contain about future levels of income. When uncertainty increases consumers postpone durable purchases until balance sheet conditions improve.

2.3 Uncertainty and aggregate trade

Previous literature does not suggest a consensus about how the (S,s) type micro-level behaviour will translate to the aggregate level. As outlined in the previous section, while Eberly (1994) and Bertola et al. (2005) claim that there are strong aggregate implications resulting from uncertainty faced by individual consumers, Foote et al. (2000) are rather sceptical about a sizeable aggregate adjustment. However, the latter study does not consider a situation in which the whole economy faces a major shock and all agents are suddenly subject to high levels of uncertainty.

Under these circumstances one could reasonably expect that a high aggregate effect will be observed if all agents that were due to adjust in the period of the shock suddenly decide to postpone their investments and consumption decisions. The real-option effect from increased uncertainty over economic and business conditions thus is likely to cause an initial and sudden drop in activity as many agents respond to the mechanisms described previously and pause investment, hiring and consumption at once. As the uncertainty subsides there might be an overshoot in activity arising via both, the producer and consumer uncertainty channel. Connecting this to trade, it is uncertainty on the buyer side that matters. In the presence of domestic uncertainty we should therefore not expect a large impact on exporters unless the uncertainty abroad is correlated with domestic uncertainty. If the importers are not subject to shocks themselves, the most affected producers will be those focusing on domestic demand. Theoretically, if the period of heightened domestic uncertainty is protracted, local producers could potentially start redirecting their sales towards foreign markets and thus boost exports. On the other hand, the consequences of high uncertainty abroad can be very damaging for exporters. A big drop in durable consumption and investment goods purchases may have very strong aggregate consequences for exporters specialising in this type of goods.

Based on the insights from the literature on the impact of uncertainty on investment and consumer spending, we can reasonably expect the impact of uncertainty on trade to be non-linear. This non-linearity is likely to arise for two reasons. The (S,s) model suggests that trade will react only if the uncertainty shock is sufficiently high. Second, because of consumer heterogeneity uncertainty needs to affect most producers and consumers to trigger a trade reaction. As pointed out by Foote et al. (2000) not all consumers adjust at the same time. Therefore, in relatively normal times when only some of the consumers face uncertainty about their future income stream and employment prospects and the aggregate uncertainty is relatively low, the aggregate adjustments should happen relatively regularly and smoothly. However, in times of extreme uncertainty the adjustment bands for most consumers will widen and we are more likely to observe a substantial overreaction of durable purchases while non-durables should be affected only marginally.

Major uncertainty shocks often overlap with other turbulent events characterised by stock market crashes reducing the wealth of the economy and reducing access to finance. Previous studies imply that both should have implications for the behaviour of economic agents when making decisions about adjusting their stocks of durables or investment goods. As these purchases are costly to reverse, consumers and producers are likely to wait when their access to finance gets restricted. Similarly, a reduction in wealth will imply that agents adjusting their stocks in proportion to wealth will now have a higher than desired stock and will thus prefer to wait or even attempt to disinvest from their existing stock. Therefore, exporters, and particularly those focusing on sales of goods that are hard to resell, should expect a further reduction in trade if the importer uncertainty is accompanied with a major hit to the real economy.

To summarise, based on guidance from previous literature we expect the following parameters to matter for the aggregate response of trade in the downturn and in the recovery. First, importer uncertainty should matter more for exporters than domestic uncertainty. Second, the size of the shock should also matter, with a potentially non-linear effect. Third, liquidity constraints and large adjustments in wealth, which tend to accompany major uncertainty shocks, will be aggravating the contraction of expenditures. Finally, the adjustment costs should also matter. We expect that countries that specialise in goods entailing high adjustment costs (such as durables or investment goods) should experience a heightened impact of uncertainty on exports. Exports of non-durables on the other hand could potentially be boosted due to the fact that consumers have a higher disposable income that they can devote to these goods, due to the savings on durable goods.

3 Producer and consumer uncertainty: a VAR analysis

As a preliminary test of the hypotheses outlined above we focus on US data and conduct a vector autoregression (VAR) analysis analogous to that of Bloom (2009). He estimates a standard VAR model that includes stock market volatility used as a proxy for uncertainty and the following additional variables: the S&P 500 stock market index, federal funds rate, average hourly earnings, consumer price index, hours in manufacturing, employment in manufacturing and industrial production. His sample covers the period June 1962 to June 2008 which comprises seventeen uncertainty shocks that are depicted in Figure 1. For reasons discussed in Section 4.2 of this paper he works with a stock market volatility based measure of uncertainty. Rather than working with stock market volatility explicitly he chooses to work only with periods of exceptional uncertainty during which the measured volatility exceeded the mean by at least 1.65 times the standard deviation. The identification of the uncertainty shock is achieved through a standard Cholesky decomposition with the uncertainty shocks ordered after the stock market index so that the effect of the stock market is already accounted for when looking at the effect of the uncertainty shocks.

In order to extend Bloom's analysis, which only focuses on the impact of uncertainty of production, we augment this baseline VAR in several ways. To assess the impact of uncertainty shocks on consumption we add consumption expenditures in the model. To further disentangle the effects of consumer uncertainty, we split the consumption expenditures into a durable and non-durable component. Finally, as the focus of this paper is on international trade, we augment the VAR with monthly import and export levels. Given that many uncertainty periods occur at times of major financial constraints and stock market crashes we also take a brief look at the impact of these effects on our variables of interest. We use the same dataset as in Bloom (2009). Additional variables, not included in Bloom's dataset, are taken from the Federal Reserve Economic Data (FRED) of the St. Louis Fed.

Figure 2 reproduces Bloom's original results. Unlike in his paper we use 4 lags instead of 12. We make this choice based on the information criteria that suggest using between three and five lags with the Schwarz Bayesian criterion pointing to four. However, this decision does not substantially affect the results of the VAR reported by Bloom. Figure 2 shows that in response to a one standard deviation increase in uncertainty industrial output initially drops down. As Bloom further explains with his theoretical model this is because the inaction bands of firms increase, leading to a freeze in activity. As uncertainty retrenches a burst of activity takes place. Because of the freeze and burst in activity, recovery takes the form of a rapid catching up phase and a temporary overshoot over the medium term. To make up for the shortfall in investment, exacerbated by the depreciation of existing goods and capital, firms spend at a faster pace than usual. Hence, there is an initial overshoot in production activity. However, over the long term, industrial production returns to trend. The responses to first order stock market shocks and to shocks to the federal funds rate are also in line with Bloom's original results. Stock market increases affect production positively and hikes in federal funds rate lead to protracted drops in industrial activity.

To shed light on the consumer behaviour under uncertainty we augment the baseline VAR with consumer expenditures. Figure 3 shows the impulse responses of industrial production and consumption expenditure to one standard deviation increases in uncertainty, stock market index and federal funds rate. The reactions of the industrial production are consistent with the results in Figure 2. Interestingly, when comparing the reactions with those of industrial production the aggregate consumption expenditures follow a very similar pattern in response to all three shocks. Consumption drops in response to uncertainty and rises over trend during the recovery. However, the overshoot is less pronounced. Unsurprisingly a rise in stock market that makes consumers wealthier increases aggregate expenditures. In contrast, a monetary policy contraction that leaves consumers financially constrained leads to a protracted drop in spending.

Most of the existing literature on the real effects of uncertainty suggests that durables are likely to be the segment of consumption most elastic to uncertainty shocks. We test this prediction by estimating a second VAR specification, where consumption expenditure is accounted for by distinguishing between the durable and a non-durable components. Figure 4 shows the impulse response functions derived from this estimation. The results suggest that the initial drop in consumption expenditures observed in response to an uncertainty shock is mainly driven by durable expenditures that are also the main driver of the medium-term overshoot. However, it also seems that the protracted nature of the drop is driven mostly by non-durables, which do not drop as much as durables, but stay below trend longer. Both durable and non-durable consumption respond positively to favorable stock market shocks, which implies that consumers do not spend disproportionately more on one of the categories in response to an increase in wealth. However, the picture changes when looking at the reactions to the federal funds rate. A monetary contraction leads to a protracted drop in durable consumption suggesting that American consumers secure most of it using loans. In contrast, the same rate hike boosts the consumption of non-durables. The increase in non-durable consumption could be explained by consumers substituting away from durable consumption that becomes too expensive due to the rising cost of finance. This implies that in crisis periods, such as the one following the Lehman bankruptcy, during which excessive levels of uncertainty are combined with a major credit crunch, one can expect a high initial discrepancy between durable and non-durable consumption due to both financial constraints and elevated uncertainty levels.

The final set of results shown in Figure 5 documents the response of international trade to uncertainty. We augment Bloom's original specification with the effective exchange rate and aggregate imports and exports. We do not include consumption expenditures in this estimation. Because of monthly data availability the sample is almost 20 years shorter, starting only in January 1980. Reassuringly, despite using a shorter sample and omitting some of the shocks, the response of industrial production is almost unchanged. As shown in Figure 5 the reactions of aggregate imports and exports to a rise in domestic uncertainty differ considerably. Exports experience a short sharp increase, after which they drop almost immediately to their previous path. In contrast, imports drop dramatically and the negative response is protracted. We do not have sufficiently long monthly time series to estimate the impact on the durables and non-durables components of trade separately.[5] Therefore, based on previous findings, one could speculate that most of the initial drop is driven by the durable component of imports while the protracted nature is primarily due to the non-durable part. Both imports and exports respond very similarly to changes in the stock market index. The increases in wealth leads to a rise of both above trend for an extended period. A contractionary monetary policy leads to an initial short-lived rise in aggregate imports that soon converts into a protracted drop. A potential explanation for this is that initially the appreciation brought by a rise in interest rates makes foreign goods cheaper, however, over time the restrictive

[5] To our knowledge, the only cross-country dataset reporting monthly (and quarterly) bilateral trade data is Trade Map of the International Trade Centre (ITC). Market Access Map, Market Analysis Tools, International Trade Centre, www.intracen.org/marketanalysis, which provides data series starting in 2005 only.

effects induced by financial constraints take over and reduce imports. Surprisingly, exports also rise in response to a hike in the federal funds rate. Even though, one would expect a negative effect on exporters via financial constraints and appreciation, a potential explanation for this result is that the biggest exporters responsible for most of the aggregate exports are less financially constrained and with the contraction of the domestic demand might be more aggressive in selling their products abroad.

In sum, it seems that uncertainty matters in an international setting, particularly for imports. In the subsequent sections we look at whether the preliminary results provided by the VAR analysis conducted on US data carry through to an international setting. Specifically, we will be focusing on the impact on exports of importer uncertainty. This, based on the preliminary results, is expected to be more important for exporters than uncertainty experienced at home.

4 Importer uncertainty in bilateral trade data

4.1 Methodology

In accordance with the theoretical insights summarised above and with results from the VAR analysis, we focus on the effects of importer uncertainty on trade flows over the period 1990-2009. We examine the evolution of quarterly trade flows by means of a model of bilateral trade. The use of bilateral trade allows us to assess the effect of foreign uncertainty while controlling for domestic developments and additional factors that might have affected the conditions of the importing economy during uncertainty periods. The bilateral specification also helps reduce endogeneity concerns as it is unlikely that trade with one country would affect aggregate importer uncertainty. We choose a dynamic specification because there are strong economic reasons to believe that there is persistence in trade. Bun and Klaassen (2002) list established distribution and service networks and habit formation of consumers as two major reasons why yesterday's trade is a good predictor of trade with the same trading partner today. Guiso et al. (2009) add trust as an additional reason, finding that establishing trust with a foreign country leads to an increase of trade by 10 per cent. Finally, two older papers by Dixit (1989b) and Baldwin (1988) find that there is hysteresis in trade due to sunk costs. Due to all these reasons estimation of a static model would lead to an autocorrelated error and incorrect inference. Therefore, we instead estimate the following baseline autoregressive distributed lag (ARDL) specification:

$$X_{odt} = \sum_{j=1}^{n_1} \alpha_j X_{odt-j} + \sum_{j=0}^{n_2} \beta_j \mathrm{U}_{dt-j} + \sum_{j=0}^{n_3} \gamma_j Y_{dt-j} + \sum_{j=0}^{n_4} \delta_j RER_{odt-j} + \sum_{j=0}^{n_5} \phi_j REER_{odt-j} + \theta_{ot} + \eta_{od} + \varepsilon_{odt}$$

where X_{odt} are exports from country of origin o imported by destination country d in time t, $REER$ is the real effective exchange rate, RER is the bilateral exchange rate, Y is demand and U refers to uncertainty. In addition, we use two sets of fixed effects. The set of exporter time dummies θ_{ot} controls for developments in the exporter country such as current demand levels or financial conditions. Country pair effects η_{od} are included to account for any pair-specific characteristics that do not vary over time – for example distance or common language would fall in this category. We treat the effects as fixed rather than random in order to allow for correlation with other regressors. To analyse the effects of first order adjustments and financial constraints that might accompany uncertainty periods, in further analyses we augment our baseline specification with proxies for these two effects.

Given the relatively long time dimension we are working with, an OLS estimation is unbiased and consistent as long as ε_{odt} is white noise. We choose the ARDL estimation method rather than the commonly used GMM because of its preferable properties for our panel structure. While GMM has been developed for small T panels and requires stationary data, our included regressors are highly likely to be very persistent. In order for a valid estimation of the above specification we will need to make sure that any autocorrelation is removed from the error. Keeping this concern in mind we determine the optimal number of lags by testing down from a general specification.

Our focus throughout the estimation is on the impact of uncertainty on the long-run levels of trade. This means that rather than looking at the impact of the individual contemporaneous or lagged terms we will instead focus on the cumulative effect uncertainty shocks (and the remaining regressors) have on the long-run level of exports. The uncertainty multiplier, or what we shall refer to as the long-run effect in the following sections, is computed as $\frac{\sum^{n_2} \beta_j}{1-\sum_{j=1}^{n_1} \alpha_j}$ and analogously for the remaining regressors.

4.2 Data

4.2.1 Bilateral trade data

The dependent variable captures the aggregate exports between country of origin o and destination country d. The trade data to construct the dependent variable are taken from the *IMF Directions of Trade Statistics.* They cover the period from the first quarter of 1990 to the last quarter of 2009. We work with a set of 32 developed and developing countries. The sample selection is largely dictated by data availability, but we also aim at having a representative sample.

4.2.2 Uncertainty

Similarly to Bloom (2009) we use a measure of stock market volatility as a our main proxy for uncertainty. Implied volatility such as VIX would be the preferred measure, because it better reflects the sentiments about near future. However, such measure is not readily available for a large set of countries and therefore we will be using the actual volatility of the stock market in the importing country. However, Bloom (2009) demonstrated on the example of the United States, that for the subsample in which both the actual and implied volatility are available the correlation exceeds 0.8. This very high correlation should make the actual volatility an acceptable proxy. An additional argument in favour of using stock market volatility is also that this measure is correlated with many alternative measures of uncertainty used in the empirical literature. Alexopoulos and Cohen (2009) show that the variance of the stock market is highly correlated with more pragmatic measures, such as the number of times a major newspaper mentions the word uncertainty within a given period. Moreover, Bloom (2009) reports statistical evidence showing that stock market volatility is strongly linked to other measures of productivity and demand uncertainty, including the variance of firm profit growth and TFP growth and the disagreement among professional forecasters in expectations about macroeconomic variables.

In our estimations, instead of using the stock market volatility explicitly, we employ dummy variables identifying periods of exceptional uncertainty. We adopt the method suggested by (Bloom, 2009), that is, our dummy variable takes a value of one when the Hodrick-Prescott detrended stock market volatility exceeds its mean by at least 1.65 standard deviations.[6] Table 1 documents the episodes of exceptional uncertainty included in our sample of countries. It shows that during the last two decades there have been numerous uncertainty shocks in developing and advanced countries alike. Most of them coincide with times of financial turmoil, most notably during the crises in Asia, Russia and Mexico or with political shocks, as in 2001.

[6] This choice might seem somewhat arbitrary and we will be looking at different thresholds in our estimations.

4.2.3 Demand

We use the total imports of the destination country d minus the imports from the exporter o as an approximation for the absorption capacity of the importer. Subtracting the imports from the exporter avoids endogeneity problems, as suggested by (Bricongne et al., 2012). We prefer this measure to GDP partially because of data availability and partially because it is a more representative measure of the demand for foreign goods.

4.2.4 Exchange rates

Our specification includes two different controls for exchange rates: the real bilateral exchange rates RER and the real effective exchange rate $REER$. The RER is computed as a product of the bilateral nominal exchange rate and the ratio of importer to exporter CPI. Both, CPI indices and bilateral exchange rates, are taken from the *IMF International Financial Statistics (IFS)*. We derive the nominal rates using the exchange rates against the US dollar. The choice of the CPI over the PPI or other producer-related indices is due to the wider data availability. The RER is defined so that an increase means a depreciation, i.e., a boost in competitiveness. Hence, we can expect the overall effect of this variable on trade will be positive.

The $REER$ measure captures the real effective exchange rate of importer d in relation to all the trade partners except the exporter o. The effect of this variable is a priori ambiguous. An increase in this measure indicates that the real exchange rate of the importer appreciates on average towards all trade partners and competitors of exporter o. This implies that their exports to market d are cheaper and one could reasonably expect that if the exports from o are substitutable with exports from other countries, the importer will switch to new suppliers. In this case the overall effect would be negative, to signal the substitution effect. However, the sign could also be positive and signal a wealth effect. The more favourable exchange rate could mean that importer d disposes of more income to buy goods from all trade partners, including exporter o. Hence, the sign of $REER$ remains largely an empirical question. A positive sign indicates that the wealth effect prevails over the substitution effect while a negative sign that the substitution effect dominates.

4.2.5 Financial controls

Despite the fact that it is common practice to quantify uncertainty using measures of financial market volatility, there are some obvious concerns. Given the financial nature of the proxy for uncertainty, it is not possible to completely rule out an alternative story. It might well be that what depresses economic activity and demand is not uncertainty per se but a rise in financial frictions or a reduction in wealth. The uncertainty periods often occur during times of financial crises that tend to be characterised by financial frictions that make the financing of export-related costs harder. To account for this possibility we augment our baseline specification by a proxy for financial constraints. The spread between the money market rate and treasury bill rate (ted) is a commonly used measure of credit crunch. However, because of data availability we use the level of the money market rate. The two measures are very highly correlated for the subsample for which we have both ted and the money market rate, allowing us to construct the spread.

In addition to financial constraints, we also control for wealth effects, which we measure as the change in the level of real stock prices. The rationale for this is that movements in stock prices can have at the same time a wealth effect as well as an uncertainty effect. In periods of lack of confidence, a drop in consumer and investment spending and therefore trade may also be due to the decline in stock prices. In other words it is possible that a confidence crisis depresses consumption, investment and trade simply by destroying a great deal of wealth.

5 Results

5.1 Baseline results

The estimation results of our baseline specification are presented in Table 2. We have determined the optimal lag length by using the Schwarz Bayesian and Akaike criteria. They both suggest that the best specification is one that includes four lags of the dependent variable and the demand measure and two lags of the remaining variables. The criteria are very similar for a specification that includes four lags of all variables. Therefore, in the baseline results we show them both for comparison. Results of the Lagrange Multiplier test implies that this lag length also removes autocorrelation from the residuals.

Column (1) shows results for a specification with two lags on both exchange rate measures and uncertainty and column (2) reports a specification with four lags. None of the third or fourth lags is significant, therefore we will stick to using two lags throughout the rest of the paper. As shown in Table 2 the sum of the coefficients on lags of the dependent variable is lower than one which implies that the dynamic relationship is stable. The effect of uncertainty is consistently negative in all lags, but the strongest and most significant effect appears to be contributed by the first lag, that is, with a one quarter delay. The long-run effects of all variables are summarised in Table 3. Panel I shows that when including two lags our main variable of interest, the uncertainty shock faced by an importer, leads to a highly significant 11.5 per cent reduction of aggregate exports. The negative effect increases further to 15 per cent when including four lags of uncertainty. The effect of the remaining control variables on trade is in line with what one could expect. An increase in demand leads to an almost one for one increase in exports. A depreciation of the bilateral exchange rates boosts trade, but the effect is statistically insignificant. Finally, a depreciation of the real effective exchange rate leads to a drop in exports suggesting that the substitution effect described above dominates over the income effect.

Because the 2008/2009 shock has been the largest uncertainty shock experienced by most countries in our sample we also check to what extent this single period drives our results. Panels III and IV in Table 2 and Table 3 report the results obtained when limiting the sample to the pre-2007 period only. This restriction leaves the results almost exactly the same suggesting that the extreme drop in international trade observed after the Lehman Brothers bankruptcy and the subsequent return to a relatively strong path of recovery was proportional to the exceptional size of the uncertainty shock that triggered it. Hence, while quantitatively speaking the effects were much stronger, qualitatively speaking, the relationship between uncertainty and trade during the most recent crisis did not post structural differences compared with past episodes.

5.2 Financial constraints and wealth effects

Uncertainty periods often overlap with major stock market crashes and financial crises. In order to see if our uncertainty measure is just capturing the reduction in wealth or financial constraints, which would both lead to a reduction in imports, we augment our baseline specification with proxies for these two effects. The results of the estimation including the money market rate and a the adjustment in the level of real stock prices, that we refer to as wealth, are reported in Table 4. We first include each measure separately and then we estimate a specification that includes both of them. The specifications in columns (1) to (3) show the results using the whole sample while the last three columns refer to a subsample with the last quarter of 2006 as cut-off. Exchange rates and demand are included in all estimations. The results are very similar to the baseline case, but we do not report them due to space restrictions. The long-run effects of all variables are summarised in Table 5. They show that including wealth has very little bearing on the estimated effect of uncertainty. The long-run effect of the uncertainty shock stays almost exactly the same while the wealth effect itself turns out only marginally significant when included without a measure of finance and highly insignificant otherwise. The situation changes when looking at the impact of financial constraints. The effect of a rise of the money market rate, while highly significant, has only a very small economic effect. However, its inclusion reduces the impact of an uncertainty shock by about one-third – to a 7.6 per cent drop in exports.

5.3 Non-linearities

In the estimations so far we have been following Bloom (2009) in defining the uncertainty shock as mean stock market volatility plus 1.65 times the standard deviation as a cut-off. The purpose of this section is twofold. First, it assesses whether the results are robust to other definitions of the cut-off. Second, using different cut-off levels provides insights into whether – as the previous literature is suggesting – there is non-linearity in the response of trade to uncertainty. We work with four different cut-off levels starting with 0.5 and increasing in increments of 0.5 up to two times standard deviation. The periods when uncertainty increases half a standard deviation above its mean are relatively frequent while there are no periods in which uncertainty exceeds the mean by more than two-and-a-half standard deviations. The results of the baseline specification and a specification including the financial constraints and wealth effects are shown in Table 6. The corresponding long-run effects are summarised in Table 7. The impact of uncertainty shocks on trade is consistently negative regardless of the chosen cut-off. However, for the lowest two cut-off levels it becomes statistically insignificant when the financial constraints and wealth controls are also included. Strikingly, the impact on trade is much more adverse when moving from the 1.5 cut-off to the highest considered cut-off level than for any other increment of the same size. Overall the results suggest that in order to see a large adverse effect on trade the uncertainty has to reach very high levels, implying that the effect on trade is indeed non-linear.

5.4 Durables versus non-durables

Much of the previous literature implies that the effect of an uncertainty shock should be channelled primarily through durable consumption, although there is no consensus on the extent to which the relationship at the microeconomic level translates into macroeconomics. In order to assess this nexus we would need bilateral monthly data by product category. As discussed earlier in the paper, these data are not available for a wide set of countries and for a sufficiently long time span. Hence, we use an indirect method to categorise trade by its durability. We compute the share of durables exported by exporter o to importer d as a share of total imports of d . We identify the shares of durables by combining ISIC3 industry level trade data from Comtrade with the classification of durable and non-durable industries compiled by Kroszner et al. (2007). Then we order all the relationships of an importer by their durability, split them into quartiles and estimate separate regressions for each quartile. In our definition the top quartile refer to relationships most intensive in durables trade. For example looking at the United States as an importer the relationship most intensive in durables is with Japan from where more than 80 per cent of total imports comprise durable goods. The relationship with lowest durability is with New Zealand that only provides 28 per cent durables in its total exports to the United States.

Tables 8 and 9 show that most of the negative effect of uncertainty on trade is generated by relationships that fall into the second and third quartile of durability. Uncertainty shocks are found to have an insignificant effect in the relationships in the top and bottom quartiles of durability. Without an explicit test of durability that uses industry level data, we cannot unambiguously determine the differential impact of uncertainty on goods of different durability. Despite this, however, the lack of significance for the effect of uncertainty on the bottom quartile of durability confirms that the latter is an important dimension for explaining the relationship between uncertainty and trade. On the other hand, the results for the top quartile of durability are more puzzling. There are several possible explanations for the lack of significance of this set of trade flows in our data. Supply chain considerations, the possibility that relationships with highest durability are also important in absolute terms or compositional and substitution effects may have a bearing on the results. For example, importers facing an uncertainty shock on the domestic market may be securing the most durable goods because these are fundamental components to their exports in the context of supply chains. Alternatively, consumers may be substituting from more durable to less-durable goods bought from the same partner with the result that the aggregate bilateral trade between two countries remains unaffected. In combination with the VAR analysis, these results suggest that the relationship between uncertainty shocks and durability deserves further analysis concerning the size and timing of both the contraction and the recovery pattern.

5.5 Prior experience with uncertainty shocks

To conclude our analysis we assess whether prior experience or more generally high frequency of shocks affects the reaction of importers to uncertainty. One could expect that countries that are often subject to volatility would react in a less extreme way to yet another uncertainty shock.[7] However, as Tables 10 and 11 show, having shocks more often has a more pronounced negative effect on trade as countries with a relatively higher incidence of shocks over the sample suffer a higher loss in trade. When, instead of splitting the sample, we explicitly control for the number of shocks the importer experienced in the past the results show almost no reduction in the long-run coefficient of uncertainty. In sum, the incidence of uncertainty shocks or extensive prior experience with uncertainty does not seem to mitigate the effects it has on trade.

[7] The limitation of this analysis is that prior experience with uncertainty shocks might already be reflected in the level of volatility itself, that is, in a country with frequent shocks the same event might lead to a lower increase in volatility compared with a country whose consumers do not have any major uncertainty event in their recent memory.

6 Conclusion

The large drop in international trade observed at the end of 2008 and the beginning of 2009 has generated considerable attention worldwide. Many commentators invoked uncertainty and the "wait and see" attitude that followed as major factors in these turbulent events. The uncertainty hypothesis predicts that when uncertainty is sufficiently high economic agents will postpone purchases, in particular of such goods that are impossible or very costly to resell. In this paper, we explore the hypothesis by focusing not only on the most recent major uncertainty event but also similar past events in a set of 32 developed and developing countries. We ask if, when controlling for other factors that tend to accompany major uncertainty shocks, uncertainty has power for explaining drops in trade. In line with the previous literature we use stock market volatility as a proxy for uncertainty and focus exclusively on periods when the measured volatility was exceptionally high. Based on theory predictions and our preliminary VAR results, we expect domestic uncertainty to affect mostly producers focused on domestic demand, while domestic exporters will be mainly affected by uncertainty abroad. To quantify the impact of importer uncertainty on their foreign suppliers, we estimate a bilateral dynamic model of trade in which we control for the developments in the exporting economy by means of fixed effects.

Our main results are the following. Uncertainty in the importer country has a strong negative effect on countries' exports. The impact gets smaller, but does not disappear, when controlling for aggravating factors such as financial constraints and wealth adjustments. We further find that uncertainty shocks affect trade flows in a non-linear fashion, that is, they need to reach a certain threshold level in order to translate into strong aggregate effects on trade. Uncertainty becomes particularly relevant, when its levels are unusually high, such as in the 2008-09 crisis of confidence. Confirming what previous literature predicts, our results suggest that adjustment costs matter. Countries specialised in non-durable and investment goods, which entail little adjustment costs, are not affected by uncertainty. However, a more thorough industry level analysis is needed to further prove the role of durability, as our results indicate that the negative effect of uncertainty on trade stems not from the trade relationships most intensive in durable goods, but from those with a more balanced mix between durable and non-durable goods.

Interestingly, our results show that the effect of uncertainty in the post-Lehman crisis did not post new structural features. The strong trade reaction was due to the size of the uncertainty shock but not to a change in the mechanisms regulating the relationship. Indeed, when excluding the most recent period from the sample we find almost exactly the same elasticity coefficients. Furthermore, we do not find evidence of learning from past shocks, because even importers with substantial past experience with uncertainty shocks overreact when faced with a new shock. A caveat here is that, because we are measuring uncertainty in terms of stock market volatility, the experience with past shocks might already be reflected in the volatility increase itself. This would mean a smaller increase in stock market turmoil in a country with high experience when compared with a country that has not experienced many extreme uncertainty events in the past, when faced with the same shock. Still, our evidence suggests that should we face a new uncertainty shock of a similar magnitude, the aggregate effects on the real economy could again be substantial. Therefore, striving for a stable economic environment free of major volatility spikes, should stay very high on the agenda of policy-makers worldwide.

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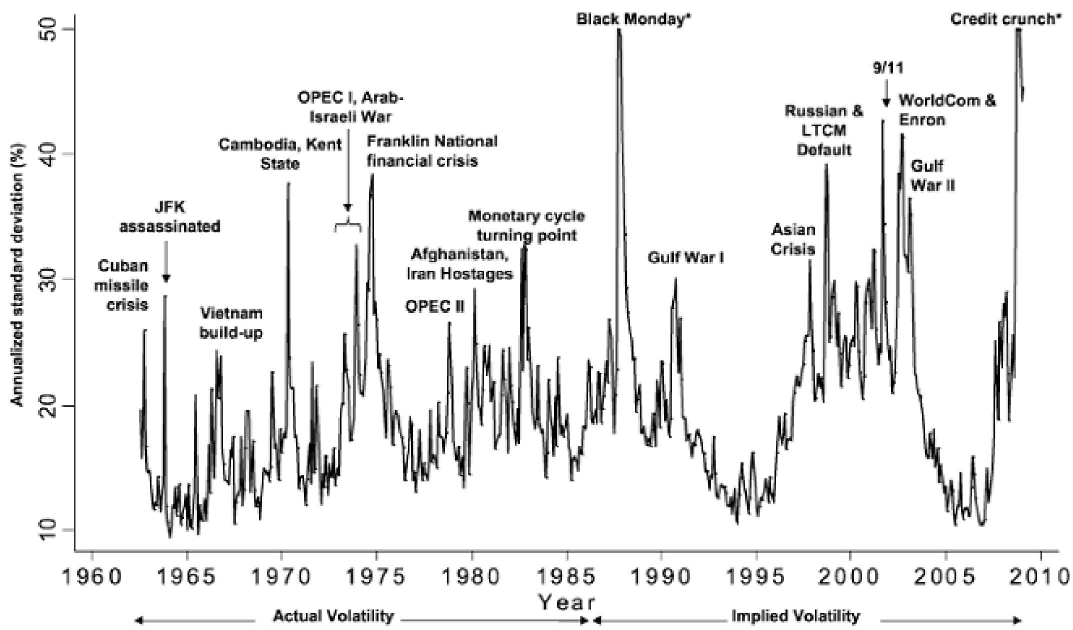
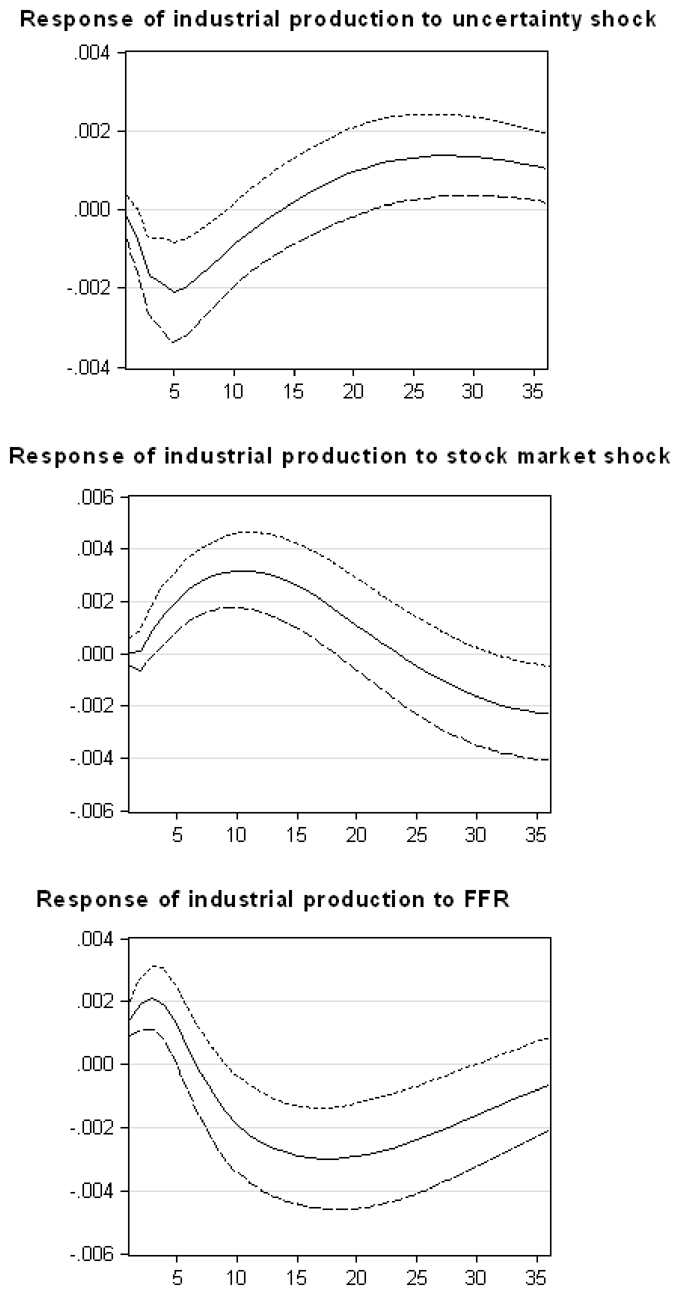
7 Tables and figures

Figure 1: Periods of exceptional uncertainty



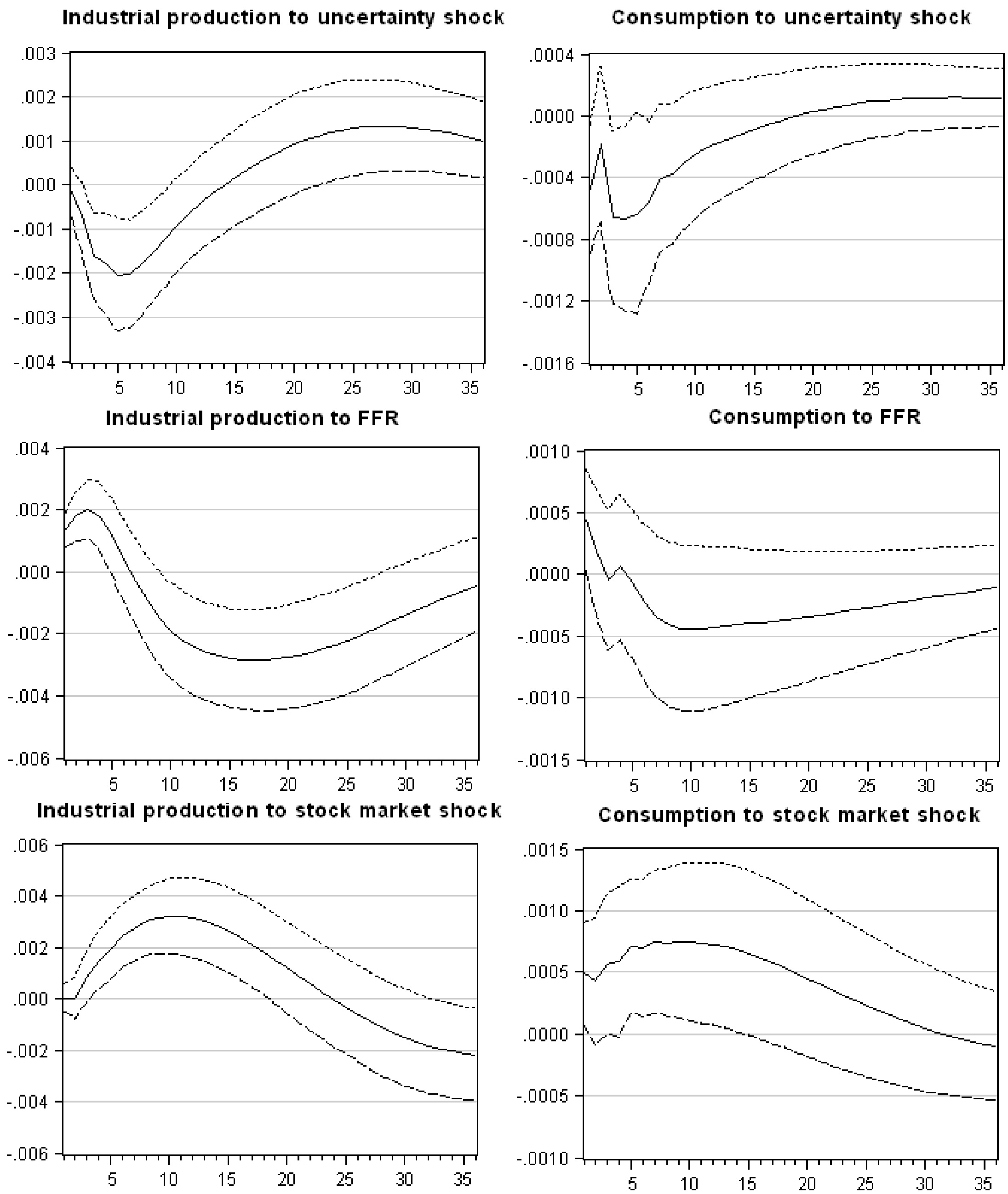
Source: Bloom (2009)

Figure 2: Domestic uncertainty impact on production



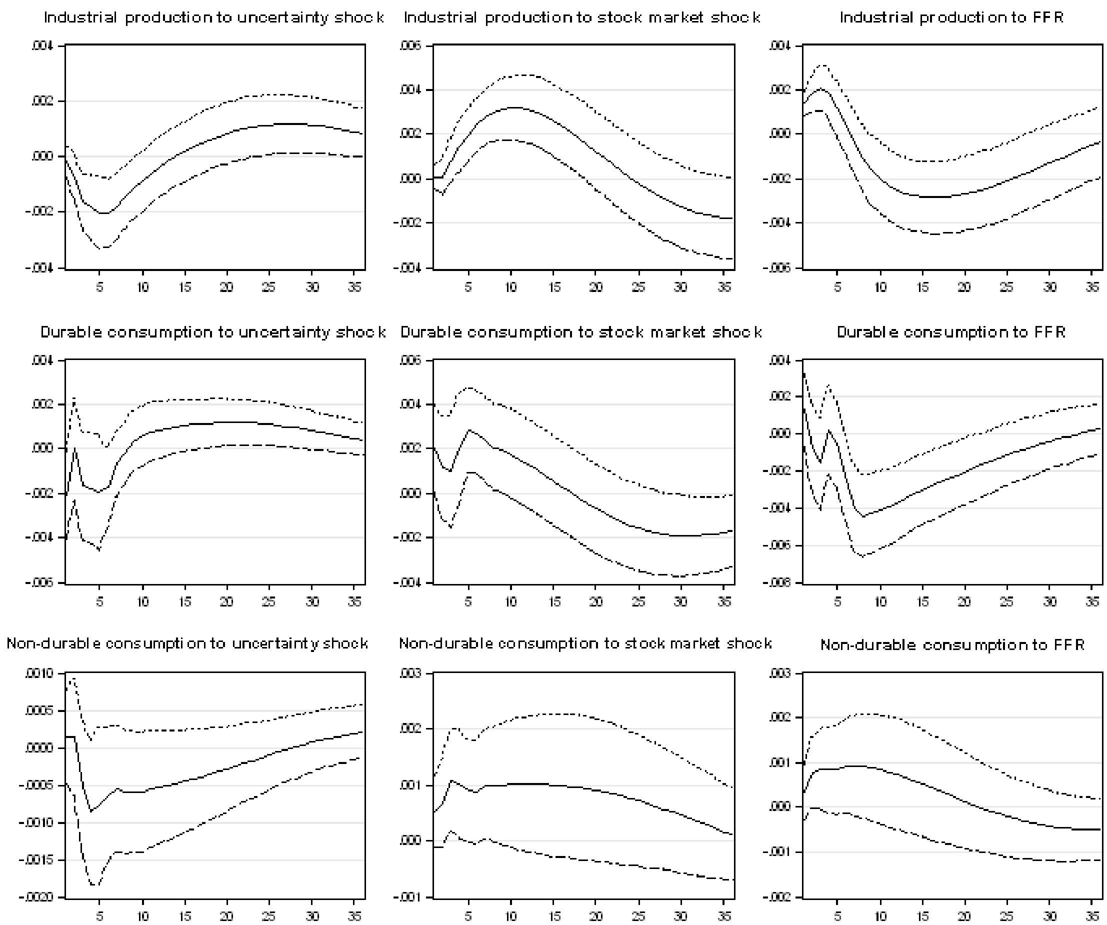
Note: Response of industrial production to innovations in uncertainty measured by stock market volatility, stock market levels and federal funds rate based on data used in Bloom (2009). The standard VAR includes the S&P500 stock market index, a stock market volatility, federal funds rate, average hourly earnings, consumer price index, hours in manufacturing, employment in manufacturing and industrial production, in this order.

Figure 3: Domestic uncertainty impact on consumption



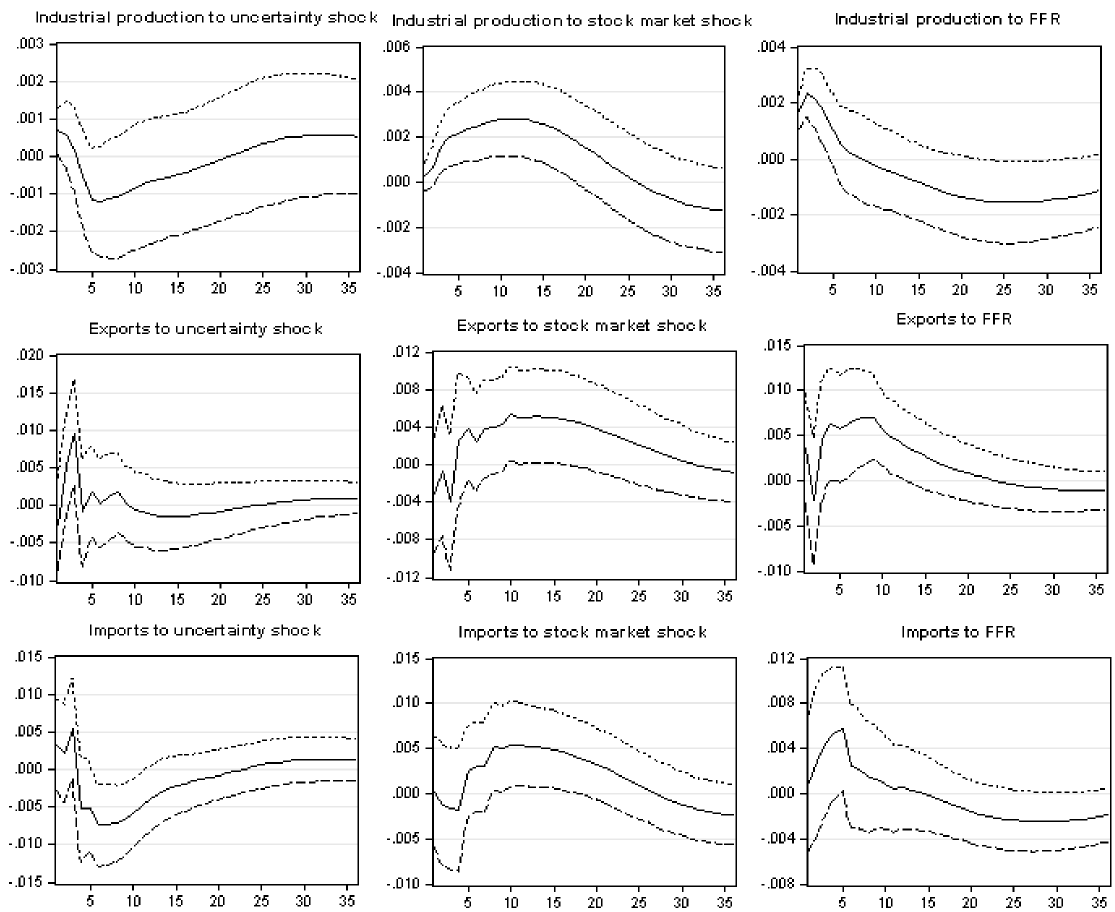
Note: Response of industrial production and consumption expenditure to innovations in uncertainty measured by stock market volatility, stock market levels and federal funds rate based on data used in Bloom (2009). The standard VAR includes the S&P500 stock market index, a stock market volatility, federal funds rate, average hourly earnings, consumer price index, hours in manufacturing, employment in manufacturing and industrial production, and consumption expenditures in this order.

Figure 4: Domestic uncertainty impact on durable consumption



Note: Response of industrial production and durable and non-durable consumption expenditure to innovations in uncertainty measured by stock market volatility, stock market levels and federal funds rate based on data used in Bloom (2009). The standard VAR includes the S&P500 stock market index, a stock market volatility, federal funds rate, average hourly earnings, consumer price index, hours in manufacturing, employment in manufacturing and industrial production, and durable and non-durable expenditures in this order.

Figure 5: Domestic uncertainty impact on trade



Note: Response of industrial production and exports and imports to innovations in uncertainty measured by stock market volatility, stock market levels and federal funds rate based on data used in Bloom (2009). The standard VAR includes the S&P500 stock market index, a stock market volatility, federal funds rate, average hourly earnings, consumer price index, hours in manufacturing, employment in manufacturing and industrial production, exchange rate, exports and imports.

Table 1: Episodes of exceptional uncertainty in 32 countries, 1990-2009

Year		affected countries	
1990	13/32	FR,DE,HK,ID(2),IT,JP,MX,NZ,SG,ES,SE,CH,TH	1 (all)
1991	6/32	AR,CN,DE,NZ,PH,ES	2(CN)
1992	10/32	CN,HK,IN(3),JP(2),KR(2),MX,NO,ZA,SE,TH	3(SE)
1993	2/32	CZ,NZ	1 (all)
1994	10/32	CN,CZ,NZ,HK,HU,MY,MX,PL (2),TH,TR(2)	2(PL,TR),3(CN)
1995	4/32	BR(2),CN,MX,PL	2(PL)
1996	2/32	CN,HU	1 (all)
1997	16/32	AU,BR,DK,DE,HK,HU,IT,JP,KR,MY(2),MX,NZ,ZA,ES,TH,TR	2(MY,HU),10(KR)
1998	24/32	AR,BR,CA,DK,FR,DE,HK(3),HU,IT(2),KR(2),MY(2),MX,NO,PH(2),	2(FR,DE,HK,HU,IT,KR,NO,PH,PL,SG,CH,TH,TR),
		PL,RU,SG(3),ZA(2),ES,SE,CH,TH(3),TR(2),GB	3(PH,RU,ZA,ES)
1999	5/32	BR,HUM,KR,PL,ES	1 (all)
2000	12/32	AU,CA (2),IN,KR,MX,NZ,PH,PL,SNG,ZA,TR (2),US	1 (all)
2001	14/32	FR,DE,HK,IT,JP,KR,NZ,PH,SNG,ES,SE (2),CH,TR,GB	2 for SE
2002	9/32	DK,FR,DE (2),ES,SE (2),CH,TR,GB,US	3(GB),4(FR,CH)
2003	5/32	FR,DE,CH,TR,GB	1(all)
2004	1/32	IN	1 (all)
2005	0/32	–	–
2006	5 /32	IN,MX,NO,ZA,TH	1(all)
2007	3/32	AU,PH,SNG	1(all)
2008	28/32	AU(3),BR,CA,CZ,DK,FR,DE,HK(2),HU,IN(2),IT,JP(2),KR,MX,	2(CZ,DK,DE,HK,HU,JP,KR,MX,SG),
		NO,NZ,PH,PL,RU,SG(2),ZA,ES(2),SE,CH,TH,TR,GB,US	3(AU,BR,FR,IT,RU,ZA,ES,CH,GB)
2009	4/32	IN,IT,GB,US	1(all)

Source: Authors' calculations.

Note: Duration is of one month, unless otherwise stated. Number next to country name indicates no. of episodes in same year.

Table 2: Baseline

	(1) 2 lags		(2) 4 lags		(3) 2 lags pre-2007		(4) 4 lags pre-2007	
	coef	**sd**	**coef**	**sd**	**coef**	**sd**	**coef**	**sd**
L.Exports	0.456***	(0.011)	0.457***	(0.011)	0.451***	(0.012)	0.452***	(0.012)
L2.Exports	0.111***	(0.012)	0.109***	(0.012)	0.105***	(0.012)	0.104***	(0.012)
L3.Exports	0.104***	(0.010)	0.105***	(0.010)	0.100***	(0.011)	0.101***	(0.011)
L4.Exports	0.123***	(0.009)	0.123***	(0.009)	0.117***	(0.010)	0.117***	(0.010)
RER	0.120***	(0.029)	0.132***	(0.029)	0.155***	(0.032)	0.162***	(0.032)
L.RER	0.022	(0.045)	0.015	(0.046)	0.009	(0.049)	0.009	(0.050)
L2.RER	-0.140***	(0.031)	-0.088*	(0.047)	-0.151***	(0.034)	-0.107**	(0.052)
L3.RER			-0.036	(0.042)			-0.051	(0.046)
L4.RER			-0.022	(0.027)			0.002	(0.030)
REER	0.044***	(0.009)	0.041***	(0.009)	0.046***	(0.009)	0.044***	(0.010)
L.REER	-0.008	(0.010)	-0.010	(0.010)	-0.012	(0.010)	-0.013	(0.010)
L2.REER	-0.013*	(0.008)	-0.016*	(0.009)	-0.012	(0.009)	-0.013	(0.010)
L3.REER			-0.003	(0.009)			-0.004	(0.010)
L4.REER			0.009	(0.008)			0.007	(0.008)
Demand	0.653***	(0.019)	0.648***	(0.020)	0.626***	(0.022)	0.625***	(0.022)
L.Demand	-0.148***	(0.025)	-0.153***	(0.025)	-0.103***	(0.028)	-0.108***	(0.028)
L2.Demand	-0.113***	(0.024)	-0.120***	(0.024)	-0.109***	(0.027)	-0.116***	(0.027)
L3.Demand	-0.098***	(0.023)	-0.092***	(0.023)	-0.101***	(0.026)	-0.094***	(0.026)
L4.Demand	-0.098***	(0.018)	-0.088***	(0.019)	-0.093***	(0.020)	-0.088***	(0.021)
Uncertainty	-0.004	(0.004)	-0.004	(0.004)	-0.009*	(0.005)	-0.009*	(0.005)
L.Uncertainty	-0.013***	(0.004)	-0.013***	(0.005)	-0.013**	(0.005)	-0.013**	(0.005)
L2.Uncertainty	-0.007	(0.005)	-0.006	(0.005)	-0.003	(0.005)	-0.003	(0.005)
L3.Uncertainty			-0.007	(0.004)			-0.004	(0.005)
L4.Uncertainty			-0.002	(0.004)			-0.001	(0.005)
Observations	73,084		72,850		59,348		59,114	
R-squared	0.984		0.984		0.983		0.983	

Note: Results of baseline estimations. The dependent variable in all columns is (log of) exports. All regressions include the exporter-year and exporter-importer fixed effects, coefficients not reported. Robust standard errors in parentheses. Significance (p-value): *10%, **5%, ***1%.

Table 3: Baseline: Long-run effects

	Variable	Coefficient	SD	t-stat	p-value
I.	**Baseline with 2 lags on shocks**				
	Variable	**Coefficient**	**SD**	**t-stat**	**p-value**
	Uncertainty	-0.115	0.035	-3.30	0.001
	Demand	0.948	0.033	28.69	0.000
	RER	0.008	0.047	0.17	0.867
	REER	0.107	0.026	4.09	0.000
II.	**Baseline with 4 lags on shocks**				
	Uncertainty	-0.152	0.043	-3.49	0.000
	Demand	0.944	0.033	28.30	0.000
	RER	0.004	0.048	0.08	0.940
	REER	0.107	0.027	3.97	0.000
III.	**Baseline with 2 lags on shocks pre-2007 sample**				
	Uncertainty	-0.114	0.036	-3.12	0.002
	Demand	0.971	0.039	24.82	0.000
	RER	0.057	0.051	1.12	0.264
	REER	0.095	0.027	3.49	0.000
IV.	**Baseline with 4 lags on shocks pre-2007 sample**				
	Uncertainty	-0.134	0.045	-2.94	0.003
	Demand	0.964	0.039	24.52	0.000
	RER	0.063	0.052	1.23	0.220
	REER	0.094	0.028	3.34	0.001

Note: Long-run effects of all control variables on international trade, computed based on the results of baseline estimations in Table 2. Significance (p-value): *10%, **5%, ***1%.

Table 4: MMR + Wealth

	(1)	(2)	(3)	(4)	(5)	(6)
Uncertainty	-0.004	-0.005	-0.005	-0.012**	-0.011**	-0.013**
	(0.005)	(0.004)	(0.005)	(0.005)	(0.005)	(0.005)
L.Uncertainty	-0.007	-0.011**	-0.003	-0.005	-0.012**	-0.001
	(0.005)	(0.004)	(0.005)	(0.005)	(0.005)	(0.005)
L2.Uncertainty	-0.008*	-0.005	-0.006	-0.004	-0.002	-0.002
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)
MMR	-0.000		0.000	-0.000		0.000
	(0.000)		(0.000)	(0.000)		(0.000)
L.MMR	-0.002***		-0.002***	-0.002***		-0.002***
	(0.001)		(0.001)	(0.001)		(0.001)
L2.MMR	0.001***		0.001***	0.001***		0.001***
	(0.000)		(0.000)	(0.000)		(0.000)
Wealth		0.050***	0.039**		0.057***	0.045**
		(0.015)	(0.016)		(0.016)	(0.018)
L.Wealth		0.014	0.012		0.003	-0.004
		(0.022)	(0.025)		(0.024)	(0.027)
L2.Wealth		-0.059***	-0.048***		-0.054***	-0.039**
		(0.014)	(0.016)		(0.015)	(0.018)
Observations		71,595	61,432		57,859	48,130
R-squared		0.984	0.986		0.984	0.986

Note: Results of baseline regressions augmented by money market rate (MMR) and stock market adjustments (Wealth). The dependent variable in all columns is (log of) exports. The lagged dependent variable and a measure of demand are included up to lag four and exchange rates up to lag two, but coefficients are not reported. All regressions also include the exporter-year and exporter-importer fixed effects, coefficients not reported. Robust standard errors in parentheses. Significance (p-value): *10%, **5%, ***1%.

Table 5: MMR + Wealth: Long-run effects

I.	**Baseline + MMR**					**IV.**	**Baseline + MMR pre-2007**				
	Variable	**Coef**	**SD**	**t-stat**	**p-val**		**Variable**	**Coeff**	**SD**	**t-stat**	**p-val**
	Uncertainty	-0.076	0.034	-2.21	0.027		Uncertainty	-0.077	0.037	-2.09	0.037
	Demand	0.722	0.041	17.55	0.000		Demand	0.737	0.052	14.10	0.000
	RER	0.106	0.055	1.93	0.054		RER	0.138	0.061	2.28	0.023
	REER	0.111	0.030	3.66	0.000		REER	0.085	0.033	2.55	0.011
	MMR	-0.009	0.002	-4.79	0.000		MMR	-0.008	0.002	-4.53	0.000
II.	**Baseline + wealth effect**					**V.**	**Baseline + wealth effect pre-2007**				
	Uncertainty	-0.105	0.034	-3.05	0.002		Uncertainty	-0.104	0.036	-2.90	0.004
	Demand	0.964	0.036	26.58	0.000		Demand	1.016	0.043	23.73	0.000
	RER	0.038	0.047	0.80	0.423		RER	0.063	0.052	1.21	0.224
	REER	0.100	0.027	3.73	0.000		REER	0.087	0.028	3.11	0.002
	Wealth	0.024	0.013	1.83	0.067		Wealth	0.026	0.013	1.94	0.052
III.	**Baseline + MMR + wealth effect**					**VI.**	**Baseline + MMR + wealth effect pre-2007**				
	Uncertainty	-0.066	0.034	-1.93	0.054		Uncertainty	-0.068	0.037	-1.85	0.064
	Demand	0.704	0.043	16.44	0.000		Demand	0.722	0.053	13.54	0.000
	RER	0.124	0.054	2.29	0.022		RER	0.144	0.060	2.40	0.016
	REER	0.099	0.031	3.21	0.001		REER	0.070	0.034	2.06	0.039
	MMR	-0.005	0.001	-3.57	0.000		MMR	-0.004	0.001	-3.27	0.001
	Wealth	0.014	0.016	0.90	0.368		Wealth	0.011	0.015	0.71	0.477

Note: long-run effects of all control variables on international trade, computed based on the results of baseline estimations in Table 4. Significance (p-value): *10%, **5%, ***1%.

Table 6: Non-linearity

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	SD*0.5	SD*0.5	SD*1	SD*1	SD*1.5	SD*1.5	SD*2	SD*2
Uncertainty	0.000	-0.001	-0.001	-0.001	-0.006	-0.006	-0.011**	-0.009*
	(0.003)	(0.003)	(0.004)	(0.004)	(0.004)	(0.004)	(0.005)	(0.005)
L.Uncertainty	-0.008**	-0.005	-0.009**	-0.003	-0.009**	-0.000	-0.018***	-0.007
	(0.003)	(0.003)	(0.004)	(0.004)	(0.004)	(0.004)	(0.005)	(0.005)
L2.Uncertainty	-0.000	0.002	-0.003	-0.001	-0.007	-0.006	-0.013***	-0.012**
	(0.003)	(0.003)	(0.004)	(0.004)	(0.004)	(0.004)	(0.005)	(0.005)
MMR		0.000		0.000		0.000		0.000
		(0.000)		(0.000)		(0.000)		(0.000)
L.MMR		-0.002***		-0.002***		-0.002***		-0.002***
		(0.001)		(0.001)		(0.001)		(0.001)
L2.MMR		0.001***		0.001***		0.001***		0.001***
		(0.000)		(0.000)		(0.000)		(0.000)
Wealth		0.040**		0.040**		0.039**		0.036**
		(0.016)		(0.016)		(0.016)		(0.016)
L.Wealth		0.014		0.012		0.013		0.012
		(0.025)		(0.025)		(0.025)		(0.025)
L2.Wealth		-0.051***		-0.050***		-0.049***		-0.044***
		(0.016)		(0.016)		(0.016)		(0.016)
Observations	71,595	61,432	71,595	61,432	71,595	61,432	71,595	61,432
R-squared	0.984	0.986	0.984	0.986	0.984	0.986	0.984	0.986

Note: Results based on different definitions of uncertainty thresholds. SD stands for standard deviation and the number in front refers to the threshold level that has been used to construct the Uncertainty measure. The dependent variable in all columns is (log of) exports. The lagged dependent variable and a measure of demand are included up to lag four and exchange rates up to lag two, but coefficients are not reported. All regressions also include the exporter-year and exporter-importer fixed effects, coefficients not reported. Robust standard errors in parentheses. Significance (p-value): *10%, **5%, ***1%.

Table 7: Non-linearity: long-run effects

I.	Baseline, Shock = 0.5*SD					V.	Baseline, Shock = 1.5*SD				
	Variable	**Coef**	**SD**	**t-stat**	**p-val**		**Variable**	**Coeff**	**SD**	**t-stat**	**p-val**
	Uncertainty	-0.040	0.023	-1.74	0.082		Uncertainty	-0.104	0.032	-3.22	0.001
	Demand	0.972	0.034	28.60	0.000		Demand	0.962	0.034	28.38	0.000
	RER	0.017	0.047	0.35	0.724		RER	0.021	0.047	0.45	0.655
	REER	0.108	0.026	4.12	0.000		REER	0.110	0.026	4.21	0.000
II.	**Baseline+MMR+Wealth, Shock = 0.5*SD**					**VI.**	**Baseline+MMR+Wealth, Shock = 1.5*SD**				
	Uncertainty	-0.016	0.023	-0.68	0.493		Uncertainty	-0.058	0.032	-1.83	0.068
	Demand	0.710	0.043	16.60	0.000		Demand	0.704	0.043	16.41	0.000
	RER	0.124	0.054	2.29	0.022		RER	0.125	0.054	2.32	0.020
	REER	0.097	0.031	3.14	0.002		REER	0.099	0.031	3.21	0.001
	MMR	-0.005	0.001	-3.65	0.000		MMR	-0.005	0.001	-3.60	0.000
	Wealth	0.012	0.016	0.78	0.434		Wealth	0.014	0.016	0.87	0.385
III.	**Baseline, Shock = 1*SD**					**VII.**	**Baseline, Shock = 2*SD**				
	Uncertainty	-0.065	0.028	-2.33	0.020		Uncertainty	-0.205	0.040	-5.11	0.000
	Demand	0.965	0.034	28.50	0.000		Demand	0.962	0.034	28.47	0.000
	RER	0.018	0.047	0.39	0.697		RER	0.025	0.047	0.52	0.600
	REER	0.109	0.026	4.17	0.000		REER	0.106	0.026	4.09	0.000
IV.	**Baseline+MMR+Wealth, Shock = 1*SD**					**VIII.**	**Baseline+MMR+Wealth, Shock = 2*SD**				
	Uncertainty	-0.022	0.028	-0.77	0.444		Uncertainty	-0.127	0.039	-3.24	0.001
	Demand	0.708	0.043	16.54	0.000		Demand	0.708	0.043	16.56	0.000
	RER	0.124	0.054	2.30	0.022		RER	0.122	0.054	2.26	0.024
	REER	0.097	0.031	3.16	0.002		REER	0.099	0.031	3.21	0.001
	MMR	-0.005	0.001	-3.64	0.000		MMR	-0.005	0.001	-3.41	0.001
	Wealth	0.013	0.016	0.80	0.422		Wealth	0.016	0.016	0.99	0.321

Note: long-run effects of all control variables on international trade, computed based on the results of baseline estimations in Table 6. Significance (p-value): *10%, **5%, ***1%.

Table 8: Durables

	(1) Top quartile	(2) Third quartile	(3) Second quartile	(4) Bottom quartile
Uncertainty	-0.009	0.007	-0.015*	-0.008
	(0.009)	(0.009)	(0.009)	(0.010)
L.Uncertainty	0.005	-0.021**	-0.015*	-0.013
	(0.010)	(0.009)	(0.009)	(0.009)
L2.Uncertainty	0.004	-0.020**	-0.008	-0.001
	(0.010)	(0.009)	(0.009)	(0.010)
Constant	-1.213***	-1.215***	-0.853***	-0.654***
	(0.175)	(0.208)	(0.148)	(0.129)
Observations	18,988	19,020	16,470	18,606
R-squared	0.982	0.985	0.988	0.987

Note: Impact of uncertainty at different levels of durability of a trading relationships. Trading relationships for each importers are split into quartiles by the share of durables traded with the top quartile referring to the highest share of durables. The dependent variable in all columns is (log of) exports. The lagged dependent variable and a measure of demand are included up to lag four and exchange rates up to lag two, but coefficients are not reported. All regressions also include the exporter-year and exporter-importer fixed effects, coefficients not reported. Robust standard errors in parentheses. Significance (p-value): *10%, **5%, ***1%.

Table 9: Durables: long-run effects

	Variable	Coefficient	SD	t-stat	p-value
I.	**Durables: top quartile**				
	Variable	**Coefficient**	**SD**	**t-stat**	**p-value**
	Uncertainty	0.003	0.072	0.04	0.971
	Demand	1.041	0.067	15.64	0.000
	RER	0.084	0.095	0.89	0.375
	REER	0.128	0.051	2.53	0.012
II.	**Durables: third quartile**				
	Uncertainty	-0.142	0.060	-2.38	0.017
	Demand	0.978	0.069	14.22	0.000
	RER	0.032	0.080	0.40	0.690
	REER	0.206	0.045	4.52	0.000
III.	**Durables: second quartile**				
	Uncertainty	-0.205	0.076	-2.70	0.007
	Demand	1.036	0.078	13.28	0.000
	RER	0.183	0.111	1.65	0.099
	REER	0.002	0.060	0.04	0.968
IV.	**Durables: bottom quartile**				
	Uncertainty	-0.122	0.085	-1.43	0.153
	Demand	0.860	0.066	13.10	0.000
	RER	-0.223	0.116	-1.93	0.053
	REER	0.110	0.065	1.69	0.091

Note: long-run effects of all control variables on international trade, computed based on the results of baseline estimations in Table 8. Significance (p-value): *10%, **5%, ***1%.

Table 10: Incidence of shocks: long-run effects

	(1)	(2)	(3)	(4)	(5)	(6)
	Low Incidence		High Incidence		Experience	
Uncertainty	0.006	0.006	-0.003	-0.002	-0.004	-0.006
	(0.007)	(0.008)	(0.006)	(0.006)	(0.004)	(0.005)
L.Uncertainty	-0.012	-0.002	-0.016***	-0.007	-0.012***	-0.003
	(0.007)	(0.008)	(0.006)	(0.006)	(0.005)	(0.005)
L2.Uncertainty	-0.011	-0.011	-0.003	-0.002	-0.007	-0.005
	(0.008)	(0.009)	(0.006)	(0.006)	(0.005)	(0.005)
MMR		0.001		-0.000		0.000
		(0.001)		(0.001)		(0.000)
L.MMR		-0.005***		-0.002**		-0.002***
		(0.001)		(0.001)		(0.001)
L2.MMR		0.003***		0.001**		0.001***
		(0.001)		(0.001)		(0.000)
Wealth		0.058**		0.055**		0.038**
		(0.026)		(0.021)		(0.016)
L.Wealth		-0.040		0.001		0.012
		(0.040)		(0.031)		(0.025)
L2.Wealth		-0.000		-0.055***		-0.047***
		(0.026)		(0.021)		(0.016)
Experience					-0.001	-0.001
					(0.001)	(0.001)
Observations	36,098	30,995	36,986	30,437	73,084	61,432
R-squared	0.985	0.987	0.983	0.986	0.984	0.986

Note: Impact of uncertainty on countries with low versus high past incidence of shocks. Last two columns instead control for past experience with shocks explicitly. The dependent variable in all columns is (log of) exports. The lagged dependent variable and a measure of demand are included up to lag four and exchange rates up to lag two, but coefficients are not reported. All regressions also include the exporter-year and exporter-importer fixed effects, coefficients not reported. Robust standard errors in parentheses. Significance (p-value): *10%, **5%, ***1%.

Table 11: Incidence of shocks: long-run effects

	Variable	Coefficient	SD	t-stat	p-value
I.	**Low incidence of shocks: baseline**				
	Variable	**Coefficient**	**SD**	**t-stat**	**p-value**
	Uncertainty	-0.079	0.062	-1.28	0.199
	Demand	1.018	0.044	23.19	0.000
	RER	-0.096	0.063	-1.52	0.129
	REER	0.124	0.041	3.02	0.003
II.	**Low incidence of shocks: baseline + mmr + wealth**				
	Uncertainty	-0.026	0.057	-0.45	0.656
	Demand	0.603	0.065	9.31	0.000
	RER	0.150	0.072	2.10	0.036
	REER	0.128	0.040	3.19	0.001
	MMR	-0.007	0.002	-2.92	0.004
	Wealth	0.077	0.031	2.46	0.014
III.	**High incidence of shocks: baseline**				
	Uncertainty	-0.108	0.045	-2.40	0.017
	Demand	0.816	0.050	16.18	0.000
	RER	0.175	0.076	2.29	0.022
	REER	0.127	0.036	3.53	0.000
IV.	**High incidence of shocks: baseline + mmr + wealth**				
	Uncertainty	-0.052	0.046	-1.14	0.256
	Demand	0.734	0.065	11.26	0.000
	RER	0.052	0.091	0.58	0.564
	REER	0.081	0.049	1.63	0.103
	MMR	-0.005	0.002	-2.86	0.004
	Wealth	0.000	0.019	0.02	0.987
V.	**Controlling for experience with shocks: baseline**				
	Uncertainty	-0.114	0.035	-3.26	0.001
	Demand	0.946	0.033	28.44	0.000
	RER	0.011	0.047	0.23	0.816
	REER	0.107	0.026	4.10	0.000
VI.	**Controlling for experience with shocks: baseline + mmr + wealth**				
	Uncertainty	-0.064	0.034	-1.87	0.061
	Demand	0.695	0.044	15.95	0.000
	RER	0.130	0.054	2.39	0.017
	REER	0.098	0.031	3.17	0.002
	MMR	-0.005	0.001	-3.65	0.000
	Wealth	0.015	0.016	0.98	0.325

Note: long-run effects of all control variables on international trade, computed based on the results of baseline estimations in Table 10. Significance (p-value): *10%, **5%, ***1%.