



The trade comovement puzzle and the margins of international trade[☆]

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ARTICLE INFO

Article history:

Received 1 April 2013

Received in revised form 24 September 2014

Accepted 23 February 2015

Available online 13 March 2015

Keywords:

International business cycle

Extensive margin of trade

Fixed export costs

Aggregate productivity

ABSTRACT

Countries that trade more with each other tend to have more strongly correlated business cycles. Yet, traditional international business cycle models predict a much weaker link between trade and business cycle comovement. We propose that fluctuations in the number of varieties embedded in trade flows may drive the observed comovement by increasing the correlation among trading partners' aggregate productivity. Our hypothesis is that business cycles should be more strongly correlated between countries that trade a wider variety of goods. We find empirical support for this hypothesis. After decomposing trade into its extensive and intensive margins, we find that the extensive margin explains most of the trade–productivity and trade–output comovement. This result is striking because the extensive margin accounts for only a fourth of the variability in total trade. We then develop a two-country model with heterogeneous firms, endogenous entry, and fixed export costs, in which the aggregate productivity correlation increases with trade in varieties. A numerical exercise shows that our proposed mechanism increases business cycle synchronization compared with the levels predicted by traditional models.

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1. Introduction

Countries that trade more with each other tend to have more strongly correlated business cycles (Frankel and Rose, 1998; Clark and Van Wincoop, 2001; Baxter and Kouparitsas, 2005; Kose and Yi, 2006). However, traditional international business cycle (IBC) models predict only a

weak link between trade and output comovement.¹ Kose and Yi (2006) propose several solutions to what they call the “trade comovement puzzle”. In particular, they find that (i) aggregate productivity shocks are also more strongly correlated across countries that trade more with each other and (ii) calibrations of the standard model that account for this fact are able to fully capture the trade–output comovement observed empirically. Yet, the underlying mechanisms that connect trade and productivity comovement remain unexplained.

We hypothesize that fluctuations in the number of goods (or varieties) embedded in trade flows may be one of the forces driving productivity comovement and thereby output comovement. Indeed, research

[☆] We appreciate the helpful comments of Roger Farmer, Antonio Fatas, Ana Cecilia Fielér, Delfim Gomes, Denis Gromb, Dong He, Jean Imbs, Ayhan Kose, Fernando Leibovici, Philippe Martin, Linda Tesar, and Jaume Ventura, as well as those of the seminar participants at NYU, Universidad Autonoma de Madrid, Georgetown University's McDonough School of Business, Hong Kong Institute for Monetary Research, the Hong Kong University of Science and Technology, City University of Hong Kong, Copenhagen Business School, the Seventh Annual Workshop on Macroeconomics and Global Interdependence (MGI), the Second Joint Macro Workshop (Paris), Tel-Aviv University, Haifa University, SED 2012, EEA-ESEM 2012, the IMF, Georgetown University, the Federal Reserve Bank of St. Louis, and the CEPR Workshop on international trade, finance, and macroeconomics. We are very grateful to Fabio Ghironi and Marc Melitz for sharing their MATLAB codes and to Jonas Heipertz and Rony Wong for their excellent research assistance. The authors acknowledge the financial support from a EUROPLACE grant. All remaining errors are ours. For Ana Maria Santacreu, the views expressed herein are those of the author and do not necessarily represent those of the Federal Reserve System, the Board of Governors, or the Regional Federal Reserve Banks. For Wei Liao, the views expressed herein are those of the author and should not be attributed to the IMF, its Executive Board, or its management.

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¹ In the standard IBC model (Backus et al., 1995), which is driven by productivity shocks, two opposing forces determine the trade–output comovement. First, more trade leads to more synchronization by increasing the demand for foreign products (*demand complementarity* effect). Second, greater integration induces a stronger reallocation effect toward the most productive country, lessening synchronization (*resource-shifting* effect). When markets are complete, the latter effect dominates. In addition to these standard channels, a third channel—the *terms of trade* effect—has an ambiguous sign. An economy experiencing a positive productivity shock benefits from lower prices and so increases its market share relative to other economies, which reduces business cycle synchronization. Yet foreign economies also benefit from cheaper imports, which increases synchronization. Which effect dominates depends on the elasticity of substitution between domestic or foreign intermediate goods as well as on the share of imported intermediate goods in the foreign economies.

has shown that low-frequency fluctuations of trade in varieties can explain differences in aggregate productivity growth across countries (Broda et al. 2006; Goldberg et al. 2010; Santacreu 2014). One interpretation of these findings is that technology is embedded in new goods created through innovation.² Under autarky, a country's productivity depends only on domestic technology. With international trade, however, productivity depends also on foreign technologies embedded in imported goods.³ Thus trade in varieties involves the international diffusion of technologies, which enables countries to benefit from each others' innovations. Ghironi and Melitz (2005) analyze the effect of high-frequency fluctuations in the extensive margin of trade on real aggregate variables. These authors report that when trade flows vary, either across countries or within a country over time, so does the number of goods embodied in those trade flows. Based on this premise, our hypothesis is that business cycles are more strongly correlated for countries that trade a wider variety (though not necessarily a greater quantity) of goods.⁴

We proceed in three steps. First, we find empirical support for this hypothesis. We update the trade–output and trade–productivity comovement regressions and find results in line with the literature. We then decompose trade intensity into its extensive and intensive margins. We find that the former explains most of the trade–productivity and trade–output comovement while the latter plays only a marginal role. These results hold both at high and at medium frequencies.⁵ In particular we find that, while holding the *intensive* margin constant, a doubling of the median extensive margin of trade is associated with an increase in the bilateral productivity correlation of about 0.06 and in the bilateral gross domestic product (GDP) correlation of about 0.059. When we hold the *extensive* margin constant, in contrast, doubling the median intensive margin of trade is associated with a decrease in the bilateral productivity correlation of about 0.01 and an increase of the bilateral GDP correlation of about 0.003. These estimates are statistically significant only for the extensive margin of trade. Our finding that the extensive margin explains most of the trade–productivity and trade–output comovement is striking because that margin accounts for only a fourth of the variability of bilateral trade intensity observed in the data. This suggests that countries trading a higher number of products (a higher level of the extensive margin)—and not more of each product (a higher level of the intensive margin)—exhibit a greater amount of aggregate productivity comovement and output comovement.

Second, we illustrate our empirical results with a well-established model that explains how shocks to aggregate productivity generate movements in the extensive margin that affect output comovement across pairs of countries. In this model, the higher is the steady-state level of the extensive margin between two countries, the stronger is the effect of productivity shocks on the comovement of business cycles through fluctuations in that margin. We build upon Ghironi and Melitz (2005) and Alessandria and Choi (2007) to develop a two-country IBC

model with the following additional features.⁶ First, there is capital and an endogenous labor supply. Second, there is trade in differentiated intermediate goods (varieties).⁷ Third, the dynamics of “welfare-based” aggregate productivity are mainly driven, at both low and high frequencies, by the number and average productivity of domestic and foreign varieties; this is the mechanism we propose to explain the trade comovement puzzle.⁸ Fourth, variations in trade are induced by iceberg transport costs (which affect mainly the intensive margin of trade) and the fixed export costs associated with entry regulations (which affect mainly the extensive margin). In each country, a firm produces a nontraded final good using domestic and foreign varieties. Production involves “love of variety” à la Ethier (1982), so production efficiency (i.e., aggregate productivity) increases with the number and average productivity of varieties used. Intermediate producers are heterogeneous in productivity and face sunk costs of entry into the domestic market and fixed costs of serving the foreign market. In the model, each firm is associated with a different variety. Forward-looking firms formulate entry and export decisions based on their expected future profits. Only a subset of the most productive firms serves the foreign market—a fact that generates variations in the extensive margin of trade across pairs of countries. Exogenous shocks to aggregate productivity alter the composition and average productivity of domestic and foreign varieties in each country. We consider only those productivity shocks that are uncorrelated across countries while focusing on the correlation between the endogenous component of countries' aggregate productivity.

Two channels strengthen the correlation of GDP growth rates between trading partners. The first channel is the traditional demand–supply spillover effect, which is present in standard IBC models but quantitatively too small to explain the trade–output comovement observed in the data. A second (albeit less direct) channel results from entry, at business cycle frequencies, into domestic and foreign markets. Following a positive transitory shock to domestic aggregate productivity, domestic final producers increase their demand for foreign intermediate goods, which in turn increases foreign output; this is the standard demand–supply channel. In addition, however, higher productivity induces entry into both domestic and foreign markets. Indeed, the country experiencing a positive productivity shock exports varieties, each of which has a higher average productivity, and these exports increase each trading partner's endogenous aggregate productivity. Higher aggregate productivity increases output both directly through the production function and indirectly by increasing the demand for intermediate goods even more, which amplifies the demand–supply channel present in the standard IBC model. The strength of the endogenous productivity effect is higher when export fixed costs are lower. An important prediction of our model—one that allows us to illustrate our empirical results—is that countries with higher steady-state levels of the extensive margin also exhibit greater propagation of shocks due to changes in this margin. In other words, the importance of the extensive margin is evident not only at the steady-state level but also with respect to the transmission of shocks across countries. We describe the empirical evidence

² Burstein and Melitz (2011) show how innovative activities at the firm level amplify productivity differences between exporters and nonexporters.

³ Goldberg et al. (2009) and Goldberg et al. (2010) study India's (1991) trade liberalization and show that imports of varieties generate static and dynamic gains from trade while increasing productivity at the plant level.

⁴ Both theoretical and empirical work have highlighted how the number of goods embedded in trade flows varies with the business cycle. Ghironi and Melitz (2005) and Alessandria and Choi (2007) argue that the extensive margin of trade should not be ignored when studying trade flows. There is empirical evidence for endogenous fluctuations in available US domestic varieties (Ghironi and Melitz (2007)). Other papers that document new varieties being introduced in the US economy in conjunction with the business cycle include Axaroglou (2003), Bernard et al. (2007), and Broda and Weinstein (2007).

⁵ Comin and Gertler (2006) (R&D), and aggregate productivity over the medium term; there is also strong comovement between output and embedded technological change at both high and medium frequencies. These authors argue that the strong medium-term procyclicality of aggregate productivity can be explained by endogenous productivity. The idea is to introduce mechanisms by which investments in resources lead to greater future productivity.

⁶ Kose and Yi (2006) argue that, in a two-country model, one of the countries would be the rest of the world and so the model would overstate the impact of one country on the other; hence, a three-country model is needed to accommodate the third-country effect. Although we agree that this is the right approach when calibrating to a particular pair of countries, our paper focuses on whether the mechanism is stronger for pairs of countries with tighter trade linkages. As will become clearer in the quantitative exercise, we show that pairs of countries with stronger trade linkages have more strongly correlated aggregate productivity and output.

⁷ During the past decade, the structure of international trade has shifted toward intermediate and capital goods: 78% of total trade corresponds to capital (14%) and intermediate inputs (64%), and only 22% corresponds to consumption goods. A similar decomposition into consumption, capital, and intermediate goods is obtained when one considers the number of goods traded rather than trade flows.

⁸ In Appendix H we provide evidence of high-frequency movements in the extensive margin of trade that track closely the high-frequency movements in aggregate productivity and GDP. There we focus on the case of the United States and China.

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