International Journal of Industrial Organization 35 (2014) 12–28

Contents lists available at ScienceDirect

International Journal of Industrial Organization

journal homepage: www.elsevier.com/locate/ijio

Exchange rate fluctuations, plant turnover and productivity☆

Ben Tomlin *

Bank of Canada, 234 Laurier Avenue West, Ottawa, Ontario K1A 0G9, Canada

ARTICLE INFO

Article history:
Received 22 June 2012
Received in revised form 4 March 2014
Accepted 8 May 2014
Available online 16 May 2014

JEL classification:
D21
D24
L11

Keywords:
Productivity
Exchange rates
Structural estimation
Dynamics
Micro data

ABSTRACT

In a small open economy, fluctuations in the real exchange rate can affect plant turnover, and thus aggregate productivity, by altering the makeup of plants that populate the market. This paper develops a structural model that captures the effect of plant-level productivity and real exchange rate fluctuations on plant entry and exit decisions, and how this, in turn, affects average industry productivity. Using plant-level data for a single industry, the model's dynamic parameters are estimated in two-stages using the Nested-Pseudo Likelihood algorithm and the Method of Simulated Moments. Simulations of the model are used to investigate the effects of shocks to the exchange rate process on productivity. The results suggest that, given the mechanisms highlighted in the model, transitory and permanent depreciations have similar long-term effects on average industry productivity.

1. Introduction

Aggregate productivity growth is believed to be one of the most important determinants of a country's long-term wellbeing, and as a result, there has been much work focused on uncovering the factors that affect productivity. In a small open economy, fluctuations in the real exchange rate can affect plant turnover, and thus aggregate productivity, by altering the makeup of plants that populate the market. The real exchange rate is an important determinant of both the level of competition within the domestic market, as well as foreign demand for domestic goods. Therefore, movements in the real exchange rate can affect plant profitability and thus decisions concerning market participation. Plant-level productivity is another important factor in market participation, as less efficient producers are more likely to exit the market because they are less competitive, and new entrants will tend to be more productive than exiting plants as they endeavor to overcome the costs associated with entry. It follows, then, that movements in the real exchange rate affect aggregate productivity by altering the composition of plants in the market.

The aim of this paper is to study the effect of movements in the real exchange rate on average productivity within a single industry, as brought about by plant turnover. More specifically, I investigate the market mechanism that works as follows. An appreciation of the real exchange rate increases the level of competition in the domestic market as export opportunities shrink and import competition intensifies. These pressures force less competitive plants from the market, and impel new entrants to be more productive and competitive in a strong-currency environment. The result will be an increase in average productivity. A depreciation, on the other hand, gives domestic producers respite from foreign competition as import competition weakens and export opportunities increase. Less productive firms can take advantage of this exchange rate shelter to stay in the market when they might otherwise have been forced out. In doing so, they crowd out new, more productive entrants, and continue to employ scarce resources – labor and capital – that could be reallocated to new plants in more productive ways. This will lead to a slowdown in plant turnover and a decline in mean productivity.

For both the appreciation and depreciation scenarios, there may be further dynamics in entry and exit such that in the longer run, movements in the exchange rate have little effect on average industry

☆ The work in this paper is drawn from chapter 2 of my Ph.D. dissertation at Boston University. I would like to thank my advisors, Simon Gilchrist and Marc Rysman, for their guidance and support. I am also grateful to John Baldwin (Statistics Canada) for making available the plant-level data, to Bob Gibson (Statistics Canada) for his help in preparing and interpreting the data, and to Victor Aguirregabiria, Eugene Beaulieu, Dan Trefler and two anonymous referees for their comments. This paper has also benefited from the comments of various seminar participants. Research for this paper was supported by the Statistics Canada Tom Symons Research Fellowship and the Bank of Canada. The results have been institutionally reviewed to ensure that no confidential information is revealed. The views expressed in this paper are those of the author and no responsibility for them should be attributed to the Bank of Canada.

* Tel.: +1 613 782 8158.
E-mail address: btomlin@bankofcanada.ca.

http://dx.doi.org/10.1016/j.ijindorg.2014.05.002
0167-7187/

productivity (depending on entry and exit costs). For example, in the case of a depreciation, where firms stay in the market where they might otherwise have exited, entry in the short run can lead to an excess number of firms in the market, which eventually forces out lower productivity producers and raises mean productivity. I estimate and simulate a structural model of entry and exit that captures these mechanisms and enables the study of the short- and long-run effects of movements in the real exchange rate on average industry productivity.[1]

This paper focuses on the Canadian experience over the 1973–1997 period, and more specifically on Canada's association with the United States. The Canada–U.S. relationship offers an ideal setting for studying the effects of movements in the exchange rate on plant turnover and aggregate productivity—the U.S. is by far Canada's most important trading partner, accounting for over 80% of Canada's manufacturing imports and exports over the period being studied, and since Canada floated its nominal exchange rate in 1970, the Canadian dollar has fluctuated significantly against the American dollar. From 1973 to 1985, the Canadian dollar depreciated almost 30% against the U.S. dollar, before appreciating 23% over the 1985–1991 period, and then falling a further 19% from 1991 to 1997 (the real exchange rate followed a similar path). Many researchers have identified a persistent aggregate manufacturing productivity gap between Canada and the United States that grew throughout the 1990s (see Bernstein et al., 2002, for example), leading some to speculate that the depreciation of the Canadian dollar during that decade contributed to Canada's lagging productivity (see Harris, 2001, for a summary of these positions). For this reason, developing a better understanding of the relationship between movements in the real exchange rate and aggregate productivity remains an important policy issue, and this paper contributes to this effort.

Using micro data on the Canadian agricultural implements industry, I extend the use of dynamic Markov structural models of entry and exit – generally used to study competition among a small number of plants – to a larger context in which many plants are operating in a differentiated goods market in a small open economy setting. The Canadian agricultural implements industry is characterized by a large number of competitors – averaging almost 200 plants per year – making a true model of strategic interaction computationally infeasible, as the state space grows exponentially in the number of competitors. Therefore, I assume that plants view the evolution of the number of plants as an exogenous process, but that their beliefs about the evolution of market competition are consistent with market outcomes. The model incorporates several important features of plant-level competition: (i) the effect of movements in the real exchange rate on plants' decisions concerning market participation; (ii) the effect of unobserved potential entrants on overall plant turnover; and (iii) the role that plant-level productivity plays in both (i) and (ii). I also assume that movements in the real exchange rate are exogenous to the agricultural implements industry.

To obtain estimates of the model's parameters, I propose a unique two-stage estimation technique. In the first stage, I use the Nested Pseudo Likelihood (NPL) algorithm developed in Aguirregabiria and Mira (2002) to obtain estimates of the model's dynamic parameters that characterize variable profits, along with the per-period fixed cost of operation. In the second stage, I use the Method of Simulated Moments (MSM) to recover estimates of the cost of entry and the parameters characterizing the distribution of unobserved potential entrant productivity. This framework allows for heterogeneous potential entrants who have an idea of their post-entry productivity levels before making the decision to enter the market or not (they receive a pre-entry productivity draw and have knowledge of the likely evolution of their own productivity). Previous papers have relied on homogeneous potential entrants to simplify the entry process; however, this precludes the self-selection mechanism that is necessary for understanding the effect of entry on industry productivity. This methodology contributes to the literature by providing a framework for the future analysis of larger industry dynamics using micro structural models.

Structural parameter estimates confirm that plant survival is positively (negatively) associated with depreciations (appreciations) of the real exchange rate, and that more productive plants are more likely to continue in the market than less productive producers. These results are consistent with the findings in Baggs et al. (2009), who use a reduced-form model to study the effects of movements in the exchange rate on plant survival. They are also consistent with the findings in Tomlin and Fung (2010), who use a reduced-form model to study the effects of real exchange movements on the distribution of productivity in the manufacturing sector as a whole. However, this paper makes an important contribution to this literature. The estimation of a structural model allows for the examination of the overall connection between the exchange rate, firm-level productivity, entry and exit decisions, and mean industry productivity through simulations of the model. The previous reduced-form work could not address all of these issues in a single framework.

Simulations of the model are used to examine the effects of permanent and transitory shocks to the real exchange rate process on average industry productivity and plant turnover. These counterfactuals reveal that while large shocks can lead to immediate changes in average industry productivity, they have little effect on productivity in the long run. The simulations highlight the fact that regardless of whether an exchange rate shock is permanent or transitory, in the case of a depreciation, average industry productivity initially decreases relative to the scenario with no depreciation due to the fact that low-productivity firms that would have otherwise exited, remain in the market. However, in the longer run, new entrants eventually force out these low-productivity firms, and average industry productivity returns to the level of productivity in the scenario without an exchange rate shock (if entry and exit costs are sufficiently low).

It is important to note that the model presented in this paper abstracts from some other mechanisms through which the exchange rate could affect entry and exit, and hence the productivity distribution. For example, there are no general equilibrium effects on wages and material costs. While including these factors is beyond the scope of this paper, I do provide some intuition as to what role they might play when discussing the results of the model simulations.

The rest of the paper is organized as follows. In Section 1.1, I review the literature most closely related to this paper. Section 2 describes the data used, and in Section 3, I outline how productivity estimates are recovered from the data. The structural model is presented in Section 4, while Section 5 discusses the estimation process and results. The model simulations are detailed in Section 6 and conclusions are presented in Section 7.

1.1. Related literature

There are a number of papers that provide partial evidence of the selection mechanism I aim to identify. As mentioned above, Baggs et al. (2009) use a reduced-form framework to study the effect of movements in the real exchange rate on plant survival and industry entry rates in Canada. They find that over the 1986–1997 period plant survival and industry entry rates are negatively associated with appreciations of the Canadian dollar, and that higher-productivity plants are more likely to survive during appreciations than less productive plants. Another study of the Canadian manufacturing sector by Baldwin and Gu (2003) shows that plant turnover, and in particular the replacement of less productive plants by more productive ones, was responsible for 15 to 25% of labor productivity growth from 1973 to 1997. The

[1] Within this framework, movements in the real exchange rate can be understood as demand shocks. There is a large literature on productivity responses (at the aggregate and firm level) to demand shocks that highlight different mechanisms, such as the Melitz (2003) model, where a demand shock (trade liberalization) affects the entry cutoff by raising factor prices, or the firm-level productivity-upgrading that can occur in response to demands shock, highlighted in Verhoogen (2008) and Bustos (2011).