Review of Economic Dynamics ••• (••••) •••–•••

Contents lists available at ScienceDirect

Review of Economic Dynamics

www.elsevier.com/locate/red

Large open economies and fixed costs of capital adjustment ☆

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ARTICLE INFO

Article history:
Received 17 April 2013
Received in revised form 5 May 2015
Available online xxxx

JEL classification:
C68
E22
E32
F41
F44

Keywords:
Aggregation
International business cycle models
Investment
Non-convex adjustment costs

ABSTRACT

Capital reallocation creates excess volatility in investment in many two-country open economy models. Convex adjustment costs to capital have become a standard tool to deal with this. However, current microeconomic investment models feature non-convex adjustment costs as the dominant friction. This paper analyzes fixed costs to capital adjustment in a two-country business cycle model and finds that fixed costs – unlike in closed economies – dampen aggregate investment volatilities. Moreover, convex adjustment costs can serve as a stand-in for these fixed adjustment costs when one is interested in aggregate dynamics only. Yet, the mapping between fixed and quadratic adjustment costs co-depends on other model parameters.

1. Introduction

Since Backus et al. (1992) adapted the real business cycle model to the context of international economics, it has been well known that, unlike its closed economy counterpart, the open economy real business cycle model suffers from excess volatility in investment driven by capital reallocation across countries. The introduction of trade in intermediate goods as in Backus et al. (1994) tends to mitigate the effect, but this depends crucially on parameter values and model assumptions. An ample range of applications remains in which the assumption of unobstructed, frictionless capital flows across borders implies an investment volatility relative to output far in excess of what is consistent with the data.[1] As first demonstrated by Baxter and Crucini (1993), the model's fit can be significantly improved by the introduction of convex adjustment costs to capital at the national level. Over time, this has become a standard practice.

☆ We would like to thank Russell Cooper, Marcus Hagedorn, Thomas Hintermaier, Gernot Mueller, and seminar and conference participants at the University of Basel, the University of Bonn, the EUI, the Central European University in Budapest, the 30th ZEW summer workshop for young economists, the Cologne Macro Workshop, ESEM 2011, and the meetings of the VfS 2011 for helpful comments and suggestions. Volker Tjaden thanks the DFG for supporting his research under GRK 1707: "Heterogeneity, Risk, and Economic Dynamics". Both authors thank the European Research Council for supporting the research leading to these results through funding under the European Union's Seventh Framework Programme (FTP/2007-2013)/ERC Grant agreement no. 282740.

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[1] Common examples are the cases of perfect substitutability between consumption goods in multi-country models (e.g. den Haan et al., 2011), a small open economy setting (e.g., Schmitt-Grohe and Uribe, 2003) or the presence of nominal frictions (e.g., Chari et al., 2002).

http://dx.doi.org/10.1016/j.red.2015.05.001
1094-2025/

Please cite this article in press as: Bayer, C., Tjaden, V. Large open economies and fixed costs of capital adjustment. Review of Economic Dynamics (2015), http://dx.doi.org/10.1016/j.red.2015.05.001

Yet, this practice contrasts with other macroeconomic research that builds on micro evidence on plants' investment activities. This research first argued that non-convex instead of convex adjustment costs are the dominant friction to capital adjustment at the plant or firm level (see e.g. Cooper and Haltiwanger, 2006)[2] but then also found that non-convex costs have little to no aggregate impact (in closed economy DSGE models); see, e.g., Khan and Thomas (2008).

These two findings seem to challenge the above-mentioned open economy modeling practice, but in fact they do not. We find that the Khan and Thomas (2008) result generalizes to the open economy set-up not as an "irrelevance" result but in the following sense: First, approximate aggregation[3] also holds as in Khan and Thomas (2008) in the open economy model with non-convex adjustment costs, such that we can describe the evolution of aggregates in the economy based only on aggregate economic variables.[4] Second, fixed adjustment costs dampen aggregate investment. And, third, the laws of motion that govern the evolution of aggregate variables coincide with the aggregate laws of motion generated by a representative-firm model with convex adjustment costs. Hence, the representative agent model can be viewed as a handy stand-in for describing macro dynamics.

However, this does not immediately imply that one can without doubt estimate and then use convex-cost models for policy analysis despite the dominant micro friction being non-convex costs. The Lucas critique might challenge policy predictions if the implied convex adjustment cost parameters co-depend on non-adjustment cost parameters of the model. In fact, while we find that fixed adjustment costs change aggregate investment dynamics indistinguishably from quadratic adjustment costs, we also find that the so identified quadratic costs change when non-adjustment cost parameters change, i.e., quadratic costs lack "fundamentalness".[5] To assess this, we construct matches between convex and non-convex adjustment costs varying other model parameters. In particular we vary openness to trade, idiosyncratic profitability risk, and the returns-to-scale (characterizing the mark-up firms can charge). The link between the two cost specifications is not stable with respect to these variations. It is particularly unstable to variations in parameters that directly enter the firm's trade-off between investment and non-adjustment, i.e., the mark-up and the idiosyncratic risk.

Why do we think the Khan and Thomas (2003, 2008) result generalizes in this way? Khan and Thomas studied a one-sector closed economy set-up with heterogeneous firms that face fixed adjustment costs and found that these costs are entirely irrelevant for aggregate dynamics. In their closed economy general equilibrium model, this irrelevance result arises because the household's desire to smooth consumption does not allow for much variation in savings behavior. This yields the result that small additional changes in the interest rate undo all potential aggregate effects of microeconomic lumpiness in a closed economy because individual investment timing is very sensitive to interest rate movements notwithstanding the fixed adjustment costs (see House, 2008), while savings are not. In an open economy setting, domestic savings are not the only means to finance investment and consumption smoothing can also be achieved via movements in the current account. This dampens interest rate responses which leaves room for fixed adjustment costs to matter. The effect is the stronger, the more open an economy is to trade (i.e., the smaller its home bias in consumption), such that the Khan and Thomas (2003, 2008) result also obtains when letting our model converge toward a model of two separate closed economies or when looking at two economies with perfectly correlated productivity shocks.

The remainder of the paper is organized as follows: Section 2 reviews a number of related recent contributions to the literature. Section 3 presents the model. Section 4 briefly introduces the numerical solution method. Section 5 explains parameter choices. Section 6 presents our main results: fixed adjustment costs matter but aggregate dynamics are indistinguishable from a representative-firm model with quadratic adjustment costs. Section 7 discusses how stand-in quadratic adjustment costs co-depend on other model parameters. Finally, Section 8 concludes. Appendices A–E provide more details on results, the calibration of fixed adjustment costs, and the numerical solution procedure.

2. Further related literature

A number of other recent papers have shown applications in which the non-convexity of plant-level decisions does matter in shaping aggregate dynamics. Bachmann et al. (2013) show that lumpiness in capital adjustment decisions help explain the procyclicality of the aggregate investment response to TFP shocks in US data. Fiori (2012) introduces a two-sector RBC model in which non-convex capital adjustment costs in the investment goods producing sector allow the model to replicate a hump-shaped response of aggregate investment to productivity shocks. Given that a two-country model can

[2] Convex costs as dominant investment friction would have difficulties in generating the close to zero serial correlation of plant-level investment rates (see Cooper and Haltiwanger, 2006) and their skewness and kurtosis, which exceeds significantly that of firm-level profitability (see Bachmann and Bayer, 2013, 2014). Early studies arguing for the role of non-convex adjustment costs using US data include e.g., Caballero et al. (1995), Doms and Dunne (1998), Caballero and Engel (1999) and Cooper et al. (1999) or Gourio and Kashyap (2007).

[3] See Krusell and Smith (1998).

[4] Approximate aggregation for models with heterogeneous firms and fixed costs of adjustment have been found in numerous studies and for a broad range of parameters starting with Khan and Thomas (2003). Further examples are Gourio and Kashyap (2007) and Khan and Thomas (2008), or Bachmann et al. (2013). In models with uncertainty shocks, such as Bachmann and Bayer (2014), strictly speaking, approximate aggregation breaks down since the "dispersion" of productivity also needs to be taken into account.

[5] The latter point is closely related to the one made for heterogeneous household models by Chang et al. (2010), who have recently argued for more caution when aggregating over ex post heterogeneous micro units in the presence of frictions. They look at an incomplete-markets, heterogeneous household set-up, and show that the estimated parameters of homogeneous agent models in these settings can often lack "fundamentalness" in the sense of the Lucas critique.

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