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## Trade policy and industrialisation when backward and forward linkages matter

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### ABSTRACT

This paper develops a model in which the interaction of forward and backward linkages determines the range of goods and of parts that are produced in a developing economy. Using a simple formalisation of the range and sophistication of parts used in different goods, the paper investigates the effects of trade and industrial policy. Linkages create multiplier effects, so, for example, support for final goods producers can increase the range of parts produced, broadening the industrial base and attracting entry of further final goods producers. Effects depend on whether policy is targeted at appropriate margins. Policies that expand the range of parts on the margin are likely to spark more industrialisation than policies that promote parts production within the margin (parts that are already produced domestically), or parts far beyond the margin (highly sophisticated parts not used in locally produced final goods).

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## 1. Introduction

Trade and industrialisation have been deeply entwined in economic analysis since the Industrial Revolution. Classical economists from Adam Smith onwards stressed the importance that both imports and exports played in fostering industry. At least since Alexander Hamilton and Friedrich List, economists have viewed trade policy as an important lever in national development/industrialisation plans. These thinkers typically posit economic mechanisms in which the simple removal of trade barriers fails to ensure that the economy attains its first-best allocation of resources.

The study of development – or under-development as it used to be called – was extension of this early thinking. Reflecting a widespread belief that many developing nations had the intrinsic capacity to rise into the ranks of middle income or even high income nations, the search began for the set of policies that would allow poor nations to realise their potential. Since rich and industrialised were synonymous in the centuries following the Industrial Revolution, a great deal of this search has focused on the challenge of industrialisation. In particular, many influential development economists have singled out backward and forward linkages as a set of economic mechanisms that can give rise to underdevelopment (Hirschman, 1969; Rostow, 1960).

Analysis of linkages is also increasingly important in trade theory. When various production stages were organised within a single nation, there was little harm to conceiving of the production process as a black box in which primary factors such as labour and capital are transformed into final goods. In recent years, this seemingly harmless simplification has

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become increasingly less innocuous. As internationalisation of the production process proceeds, it is becoming important to open up the production function's black-box approach and track which stages go where and why (Baldwin, 2006). The immediate problem confronted by a theorist working on this challenge is that of tractability.

Tractable models of backward and forward linkages in an open economy (Krugman and Venables, 1995; Venables, 1996) have emerged in recent decades, and been applied to trade and industrialisation (Markusen and Venables, 1999; Puga and Venables, 1999).<sup>1</sup> These models, in the spirit of the New Economic Geography models, work with highly symmetric goods – typically relying on Dixit-Stiglitz monopolistic competition and symmetrically differentiated products. In the simplest case, all firms produce an intermediate variety and use all other varieties, so they create forward and backward linkages (from their supply and demand respectively), and also benefit from forward and backward linkages created by other firms. Recently, theory has turned to more specific models of the unbundling and offshoring that focus on the decision to break up the production process across borders (Costinot et al., 2013; Grossman and Rossi-Hansberg, 2008). These papers, however, typically eschew linkages across product-specific value chains and so the backward and forward linkages exist only in a single column of the input-output matrix. Our own work in this area shares this single-industry approach (Baldwin and Venables, 2013).

The present paper posits a model that has a clear distinction between firms that produce parts and firms that use them, but which contains input-output relationships that span sectors. The model is designed to allow product-specific value chains to interact in ways that influence each other's competitiveness via backwards and forwards linkages. Several cross-product linkages are important empirically but they generally fall into two categories: those related to knowledge spillovers (R&D, learning-by-doing externalities, etc.) and those related to backward and forward linkages. In this paper, we focus on the latter. We use the model to study the impact of various trade and industrial policies, including tariffs, export and production subsidies, and local content restrictions, as well as value-chain policies.

Specifically, we look at an industry where final goods are produced using parts, with different goods using different (but overlapping) sets of parts. The range of final goods produced domestically depends positively on the range of parts produced domestically (via supply-side, or forward linkages). Simultaneously, the range of domestically produced parts depends positively upon the range of domestically produced goods (via derived-demand, i.e. backward linkages). If we call the range of parts produced the 'width' of the industrial base, and the range of final goods produced the 'height' of the industrial base, we have a model where the height of the industrial base affects and is affected by the width of the industry base.

In this setting, standard trade policy instruments have complex effects on the equilibrium level of industrialisation. For example, an across the board tariff on imported parts would normally be expected to reduce industrial competitiveness and thus reduce industrial output via the usual effective rate of protection channels. We show that, depending whether domestic parts are sufficiently good substitutes for imported parts, the parts tariff may broaden the industrial base to the point where the nation becomes competitive in a wider range of final goods. Local content restrictions and policy to attract local production of parts may have similar effects although, since different goods use different sets of parts, effects depend on industry detail and the accuracy with which such policies are targeted.

## 2. The model

Consider a small open developing economy (Home) that can potentially produce a continuum of final goods – or 'goods' for short – using a continuum of intermediate goods – or 'parts' for short. Goods are indexed  $z$  and the set of possible goods is  $z \in [0, \infty]$ ; parts are indexed  $y \in [0, \infty]$  (where the mnemonic is that parts come before final goods as  $y$  comes before  $z$ .) Determining the equilibrium range of goods and parts that are produced at Home is the primary task of this paper.

A second, more economically advanced nation (Foreign) already makes the full range of parts and goods, and Home can import these from Foreign. Home can export goods, but we assume that Home parts, i.e. parts made in the less technologically advanced nations, are uncompetitive in Foreign. That is, the coordination costs involved in using Home parts in Foreign-based production processes are prohibitively high. Although Home produced parts are not exported directly, they are embodied in Home final goods which are exported.

In an extension in Section 3.5, we allow Foreign firms to internalise the transaction costs by setting up parts production in Home. This reduces the coordination and transaction costs to the point where Home parts can be exported, but only via intra-firm trade. As we shall see, this opens the door to new questions concerning trade and industrialisation.

A key feature of the interaction among supply chains is that goods vary in the set of parts that they require, and parts vary in the set of goods that they supply. Central to the model, is the idea that the range of goods produced at Home depends on the range of parts produced, and vice versa. Only some parts are produced domestically, and these are parts for which demand exceeds a level which we will refer to as 'minimum efficient scale' (MES). As only parts for which demand exceeds their MES are produced domestically, the demand for parts that arises from one final-good sector can affect the cost conditions facing other final-good sectors. We order the parts according to their MES such that parts with higher  $y$  indices have higher MES, and we refer to these as more sophisticated parts.

<sup>1</sup> For the wider context of trade policy and industrialisation see Ref. Harrison and Rodriguez-Clare (2010).

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