

# Industrial business cycle linkages between Taiwan and the United States: Evidence from the IT industry

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## Abstract

This paper uses a two-country model to investigate the international business cycle linkage in the information technology (IT) industry between Taiwan and the United States. Using panel Lagrange Multiplier unit root and panel cointegration analysis, we find that Taiwan's IT output is predominantly determined by supply-side factors such as the supply of IT parts from the United States. Our findings provide new insights in understanding the international business cycle linkage at the industrial level.

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## 1. Introduction

Business cycle synchronization between countries is a widely studied topic and has been well documented in the literature (e.g., Artis, Hans-Martin, & Juan, 2004; and Duarte & Holden, 2003), but research on the correlation between international business cycles at the industrial level is very limited (see de Brouwer & Romalis, 1996). Business cycle linkage at the industrial level between countries can serve as a useful guide for studying international business cycles. One important aim of this paper is therefore to bridge the research gap and to examine the business

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cycle linkage of the information technology<sup>1</sup> (IT) industry between Taiwan and the United States (US). Although the industrial structures of the two economies may be different, their IT sectors are closely correlated. This correlation can be seen through the following observations.<sup>2</sup> First, while the output of the IT industry accounted for 8.5% of Taiwan's gross domestic product (GDP) and 34.7% of its total manufacturing output in 2004, more than 90% of Taiwan's IT hardware products are for export, and the US market accounted for the largest share, being 32.8% of the total shipment in 2003 and 29.6% in 2004.<sup>3</sup> Second, leading US companies are the major supplier of IT parts and critical IT components of Taiwanese manufacturers. The US supplied 22.5% of Taiwan's total imports of IT products in 1989 and 13.8% in 2004. It is worth noting that among the imported goods from the US, IT products accounted for the largest share. Their share was 40.3% in 2004, up from the 28.0% in 1989. Third, during the 1980s, there had been intense government involvement<sup>4</sup> in boosting Taiwan's IT and electronics industries. During that period, US firms replaced Japanese firms as the leading source of foreign investment in Taiwan's electronics industry. Many local companies took the opportunity to be subcontractors in OEM (original equipment manufacturer) production. Since 1983, Taiwan's IT industry had moved beyond OEM and began to be involved in original design and manufacture (ODM). US companies such as IBM, Apple, Dell, Intel, and AT&T placed ODM orders with Taiwan IT manufacturers. Fourth, more IT firms in Taiwan are involved in joint venture with US companies such as Acer and Texas Instruments to produce critical IT parts and transfer technology. Many Taiwanese manufacturers have also established their production sites in the US to be more involved in the assembly, distribution, and after-sales maintenance services of finished PCs. Despite all these relations, little is known about the business cycle linkage of the IT industries between these two economies. Frankel and Rose (1998) have suggested that closer international trade ties tend to affect the nature of national business cycles. Our analysis of the IT sector linkage between Taiwan and the US could therefore contribute to the understanding of Taiwan's national business cycle.

We will investigate the cyclical fluctuations in the IT industry of Taiwan and the US using a two-country model which is estimated by a panel of quarterly data covering seven IT products during the period 1986–2004. This paper is organized as follows. Section 2 shows the framework of the two-country IT industry linkage model, which is then used in our empirical study. Section 3 discusses the data, the panel Lagrange Multiplier unit root, and panel cointegration tests. Section 4 interprets the estimation results, and the final section narrates the conclusion.

## 2. The two-country IT business cycle linkage model

Let  $y_{i,t}^{\text{TW}}$  denote the  $i$ th IT product in Taiwan at time  $t$ , and  $y_{i,t}^{\text{US}}$  be its counterpart in the US.  $p_{i,t}^{\text{TW}}$  and  $p_{i,t}^{\text{US}}$  are the corresponding prices of the  $i$ th IT product in Taiwan and the US.  $Q_t^{\text{TW}}$  and  $Q_t^{\text{US}}$  represent the GDP (or income) of the two economies, respectively. When the assumption of the purchasing power parity is imposed, we have  $p_{i,t}^{\text{TW}} = e_t \times p_{i,t}^{\text{US}}$ , where  $e_t$  denotes the nominal

<sup>1</sup> The IT industry consists of hardware, software, information services, and telecommunications.

<sup>2</sup> These observations are basically drawn from Chapter 3 in the study of Poon (2002).

<sup>3</sup> According to Institute for Information Industry (2005), only 15.6% of the total value of shipments was produced in Taiwan in 2004, while 71.2% was produced in Mainland China.

<sup>4</sup> The government helped in capital provision, land acquisition, and the establishment of various resource centers.

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