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INTERNATIONAL PRODUCTION RELOCATION AND EXPORTS OF SERVICES

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INTRODUCTION

Cross-border trade and foreign direct investment (FDI) in services have risen markedly over the past two decades in almost all OECD economies. In part this reflects the general globalisation of economic activities over this period, as documented, for instance, by Nicoletti *et al.* (2003). But the pace of internationalisation of services has been even faster than that of non-service activities. Between 1983 and 2003 the (dollar value) share of services exports in total OECD exports of goods and services rose by over 2 percentage points, to just under 22 per cent. Estimating the share of service sector transactions in total FDI is more difficult, reflecting the relative paucity of data, but the available statistics for 16 OECD economies show that the share of service sector investments in the total stock of outward FDI from these economies rose by almost 10 percentage points, to just under two-thirds, between 1990 and 2000 (OECD, 2002). The expansion of both modes of cross-border service transactions reflects the increasing importance of service industries within national economies, as well as technological improvements in telecommunications and information flows and the ongoing liberalisation of entry into many service markets (World Bank, 2003; OECD, 2004).

One important topic that has long been the subject of interest concerns the impact, if any, that rising cross-border production relocation might have on international trade (WTO, 1996). Detailed overviews of the extant theoretical and empirical literature are provided by Pain and Wakelin (1998), Fontagné and Pajot (2001), Gestrin (2002) and van Welsum (2003b). Much of this has focused either on the issue of whether international trade and international production are complements or substitutes, or on the extent to which international production affects export performance and import penetration. Almost all empirical evidence relates to trade in manufactures. Comparatively little is known about the economic determinants of service sector trade, and the impact on this of the international relocation of service and non-service sector activities, despite the increasing importance of cross-border transactions in services. The research in this paper is intended to help fill this gap.

Firms face a number of choices as to how they can exploit new market opportunities. They can produce at home and export abroad, or produce abroad directly. In this case international production relocation and exports would be alternative ways of supplying foreign markets with finished products, but foreign production might still raise exports of intermediate goods and services. At other times a foreign market presence may be essential for transactions to take place at

all. Outward investments to establish a foreign market presence may facilitate inter and intra-firm trade in services and raise parent company sales, but equally they may raise affiliate sales, with the parent company no longer exporting services but instead receiving remitted profits. Since many cross-border investments in sectors such as financial services are stimulated by overseas investments by non-financial firms from the same home country, it may be important to look at the relationship of services exports with international production relocation in non-service sectors as well as in the services sector. Empirical evidence is required to distinguish the net impact of these differing forces.

Many of these relationships might be expected to emerge only gradually over time and potentially differ across different categories of activities. An immediate practical difficulty concerns the ready availability for many OECD countries of long-runs of time series data on both the sub-components of service sector trade and the scale of activities undertaken in foreign affiliates. For this reason we estimate a model of the economic determinants of service exports from the United States, where such data are available.[1] Trends in the internationalisation of service sector activities are even more pronounced in the United States than in the OECD as a whole. By 2003, exports of services accounted for over 30 per cent of exports of goods and services in value terms, compared with 25 per cent two decades earlier, and just over 20 per cent in the late 1970s. Service sector investments, defined broadly as total investment excluding manufacturing, mining, utilities and wholesale trade investments, represented just under 64 per cent of the total stock of outward foreign direct investment in 2003, more than twice the proportion in the early 1980s.[2]

Our empirical study utilises and extends the approach of Pain and Wakelin (1998). We use a detailed panel data set for the United States over the period 1986-2000 and model the determinants of six different categories of service exports recorded in the balance of payments data. Using a number of different econometric techniques, and a number of different measures of international production relocation, the relationship between international production relocation and exports of services is found to be sensitive to the precise empirical specification adopted, although less so to different measures of the scale of international production. Whilst it appears that foreign production and investment have an effect on the volume of exported services, after controlling for world demand and the relative price and quality of services produced in the United States, the impact of changes in the service and non-service sectors is found to differ at times. Indeed, there is evidence of considerable heterogeneity in the size and significance of the coefficients across individual categories of exports such as intra-firm transactions and transactions with unrelated third parties.

At first sight it might seem surprising to wish to test whether international production relocation has a positive or negative impact on trade in services. The

General Agreement on Trade in Services (GATS) distinguishes four modes of service trade – the cross-border supply of services (Mode 1), services provided to consumers who have travelled from abroad (Mode 2), services provided by foreign affiliates of companies to foreign consumers (Mode 3) and services supplied abroad by the presence of natural persons from another country (Mode 4).[3] Since international production relocation in the service sector is likely to result in a higher level of affiliate sales, it would seem that there should be a clear complementary relationship between production relocation and services trade, especially given the relative size of Mode 3 transactions (Karsenty, 2002).

But this broad definition of services trade does not presently correspond to that in the Balance of Payments (BoP) data on services exports that we use. The BoP statistics account for almost all trade under Modes 1 and 2, and provide a partial coverage of Mode 4, but include few Mode 3 transactions (Cave, 2002). Given this, it is quite possible for any study of the impact of production relocation on BoP exports of services to find a negative or a positive relationship after controlling for other determinants of trade.

The structure of the remainder of this paper is as follows. The next section contains a review of the existing literature on the impact of foreign production on trade. Most of the papers discussed deal with manufacturing issues rather than with those related to services, but we include some papers that have focused specifically on trade in services at the end of the section. The following sections set out the empirical model and econometric approach used, along with a short discussion of some descriptive statistics, and then the main empirical results. The final section contains some brief concluding comments about the main findings and their implications for the growing discussions about the impact of the "offshoring" of service sector activities in the main OECD economies.

FOREIGN DIRECT INVESTMENT AND INTERNATIONAL TRADE

The theoretical literature on international trade and the behaviour of multinational firms fails to give a clear indication as to whether foreign production acts as a complement to or a substitute for international trade. In the traditional Heckscher-Ohlin (H-O) model with international factor mobility, perfectly competitive markets and zero transportation costs, factor flows, such as foreign direct investment may be a substitute for trade (Mundell, 1957). Factor price equalisation can be achieved either through movement of factors or movement of goods embodying the services of those factors.

Even if the assumptions underlying this model are relaxed, it is still possible for trade and international capital mobility via FDI to be negatively related if there are barriers to trade but not market access through production relocation. Brainard (1997) develops a model in which decisions on exporting and establishing produc-

tion facilities abroad by horizontally integrated multinational firms are based on a trade-off between proximity advantages from being located close to consumers and scale advantages from concentrating production in one location. Empirical evidence in her paper, and also that of Ekholm (1998), shows that the share of foreign affiliate sales in the total of exports and affiliate sales is positively related to trade barriers and transportation costs.

This particular model is but one example of the development over the past two decades of new models that have sought to incorporate aspects of industrial organisation and multinational firms into the conventional general equilibrium model of international trade. Markusen (2002) provides a detailed overview of the development of this research and its implications. The majority of papers in this field have implicitly considered the foreign affiliates of multinational firms to be undertaking manufacturing or primary activities. Parent companies typically provide headquarter services, such as management, marketing and research and development, and export these services to their affiliates. In this sense, the international relocation of production in sectors other than services should have a positive impact on exports of services. But little formal theoretical analysis has been undertaken of the possibility of foreign affiliates undertaking service activities themselves, or the relationship between foreign production and exports of services to third parties.

Thus, theory fails to provide a clear prediction as to what the nature of the relationship between trade and FDI may be. International production may either create or displace trade, with the particular effect likely to differ between economies and industries, and depend on the motivations for cross-border investments. Cross-sectoral relationships may matter as well. For example, it is well established that cross-border investments in financial services have strong interlinkages with cross-border investments by non-financial firms from the same home country (Moshirian, 2001; Esperanca and Gulamhussen, 2001; Gross *et al.*, 2004). Given this, it may be important to look at the relationship of services exports with all forms of international production relocation, not just that within services sectors.

E*mpirical studies*

There is a growing empirical literature on the impact of international production relocation on trade. As almost all of this relates to merchandise trade, we do not provide a detailed summary of it here.[4] However there are a number of important findings which can be expected to be relevant to studies of services trade as well.

First, as emphasised by Blonigen (2001), it is quite possible that both substitution and complementarity may be observed simultaneously, depending on the level of disaggregation in the data set. In his study of the impact of Japanese automobile production in the United States, increased output of automobile parts in the United

States was found to reduce exports of automobile parts from Japan, whilst increased output of automobiles in the United States was found to have the opposite effect.

It is quite possible that substitution and complementarity effects might also be observed for trade in services. As noted above, production relocation in the service and non-service sectors may stimulate a demand for intra-firm services that are exported by the parent company. Production relocation in the services sector might be an alternative means of supplying services, especially if direct contact between supplier and consumer is important, or it may have little effect at all on services exports because it is designed to provide "downstream services" which stimulate the demand for goods produced by the parent company or other foreign affiliates.

A second important consideration is that the relationship between international production relocation and trade may change over time as affiliates mature and expand the range of activities they undertake. For example, Svensson (1996), using Swedish data for 1990, obtains evidence of a substitution effect between affiliate production and trade. Previous studies using Swedish data covering the 1970s and early 1980s had typically concluded that FDI had a complementary net effect on domestic exports, with greater market proximity serving to raise overall market share. During the earlier period increases in exports of intermediate goods more than made up for the decline in exports of finished goods, whereas in the latter period exports to third parties from the foreign affiliates of Swedish companies were found to take place at the expense of exports from the parent firm.

A third consideration, emphasised by Pain and Wakelin (1998), is that it makes little sense to study the bivariate correlation between exports and foreign direct investment over time in order to test whether the two are complements or substitutes. Both are likely to have a common trend over time, reflecting their dependence on global income levels. A more appropriate question is the effect of production relocation on export performance, as given by the ratio of exports to market size. Pain and Wakelin examine the relationship between the location of production and the merchandise trade performance of 12 OECD countries over time using an augmented export demand model. After controlling for relative price movements and quality effects through measures of relative innovation they find that outward investment tends to have a negative effect on export performance, whereas inward investment is found to generally have a positive effect. Related results for exports are reported by Barrell and Pain (1997) and for imports by Barrell and te Velde (2002).

Trade in services

The small number of empirical time series studies of the determinants of US exports of services largely model export volumes in terms of foreign income and the real exchange rate. All show that conventional models of merchandise trade

can be applied successfully to trade in services, as argued by van Welsum (2003a). Recent examples include Huang and Viana (1995), Wren-Lewis and Driver (1998), Deardorff *et al.* (2000), Ansari and Ojemakinde (2003) and Mann (2004). Most of these find that the income elasticity of demand is above unity, whilst relative price effects are comparatively small to those typically found for merchandise trade. For example, Wren-Lewis and Driver (1998, Table 4.2) use a number of different estimation techniques and find that the income elasticity of demand for the aggregate volume of exports of services lies in the range 1.50-1.95 per cent, whilst the relative price elasticity lies in the range –0.21 to –0.40 per cent.[5]

The findings of Huang and Viana (1995), Deardorff *et al.* (2000) and Mann (2004) raise the possibility of heterogeneous income and price elasticities for different categories of exports, although none of these studies seeks to test this explicitly. Huang and Viana (1995) and Deardorff *et al.* (2000, Table 1) both find higher income and price elasticities of demand for passenger fares and other travel-related exports, than for other categories of service exports. In a panel data analysis of sub-categories of business and technical services Mann (2004) reports that relative price elasticities are typically insignificant and, in some cases, do not have the expected negative sign.

Of the studies cited above, only Huang and Viana (1995) seek to consider the role of foreign direct investment on export patterns. They find that the stocks of both inward and outward foreign direct investment have separate positive effects on one category of exports, "other private services" (OPS).[6] A notable feature of their results is that inclusion of these FDI measures in an otherwise conventionally specified demand relationship results in positive, and significant, coefficients being obtained on the real exchange rate, implying that a dollar appreciation would raise export volumes, other things being equal.[7]

The only other studies of which we are aware that examine the direct impact of foreign direct investment on United States trade in services are those of Li *et al.* (2003 and 2004), who find that FDI in insurance and banking services have significant positive effects on the volume of intra-industry trade in insurance and financial services between US and foreign financial institutions. As their measures of intra-industry trade are constructed using data on exports and imports of services it is not possible to know whether the reported results stem from the impact of production relocation on exports, imports or both. Evidence of the importance of non-price factors on services trade is provided by Freund and Weinhold (2002), who find that Internet adoption, as measured by the number of web hosts in a country, has a significant positive impact on some types of bilateral trade in business services between unaffiliated parties in the United States and abroad.

Two studies provide indirect evidence of potential cross-sectional complementarities between foreign direct investment and trade in services. Both use a

gravity model of bilateral trade for a sample of OECD economies. Nicoletti *et al.* (2003) report a negative relationship between an index of the level of restrictions on inward foreign direct investment in a host country and the level of bilateral trade in services. Grünfeld and Moxnes (2003) find a significant positive correlation between the residuals from separate gravity models of services trade and bilateral FDI stocks, and argue that this provides evidence of complementarity between the unmodelled components of services trade and FDI.

Finally, in a study of Japanese trade in financial services, Moshirian (1998) finds that imports of services into Japan are negatively related to the stock of international bond loans held by Japanese residents. To the extent that such loans are obtained from foreign financial institutions located in Japan, this evidence is suggestive of substitution between exports and cross-border sales by affiliates. One additional feature of the results is that the income elasticity of demand for both exports and imports of services is found to be significantly greater than unity, consistent with the findings in many of the other studies discussed above.

ECONOMETRIC APPROACH AND DATA DESCRIPTION

The discussion above suggests that different factors may influence different types of service exports. Therefore, rather than estimate a single aggregate relationship for total exports of services, we use a panel data set and test explicitly for heterogeneous effects. We use a simple, heterogeneous, partial adjustment panel model of the form:

$$\ln(Y_{it}) = \alpha_i + \beta_i \ln(X_{it}) + \lambda_i \ln(Y_{it-1}) + u_{it};\ u_{it} \approx\ IN(0, \sigma_i^2) \qquad [1]$$

for each of i = 1…N groups, over t = 1..T observations, where X denotes a k*1 vector of independent explanatory variables. The associated long-run coefficients can be derived as $\theta_i = \beta_i/(1 - \lambda_i)$. The group-specific intercepts pick up all omitted factors that vary across groups, but not across time. A convenient reparameterisation of [1] is:

$$\begin{aligned} \Delta\ln(Y_{it}) &= \alpha_i - (1 - \lambda_i)\left[\ln(Y_{it-1}) - \frac{\beta_i}{1 - \lambda_i}\ln(X_{it})\right] + u_{it} \\ &= \alpha_i - \gamma_i[\ln(Y_{it-1}) - \theta_i \ln(X_{it})] + u_{it} \end{aligned} \qquad [2]$$

This non-linear formulation permits a direct estimate of the long-run parameters of interest. If the slope parameters are homogenous, then consistent estimates (as $T \to \infty$) can be obtained from the standard one-way fixed effects model:

$$\Delta\ln(Y_{it}) = \alpha_i - \gamma[\ln(Y_{it-1}) - \theta_i \ln(X_{it})] + w_{it};\ w_{it} \approx\ IN(0, \sigma^2) \qquad [3]$$

This model imposes both common slope parameters and common error variances across groups. Both sets of restrictions can be tested. If the restrictions do not hold, then the fixed effects model will provide inconsistent parameter estimates, even as $T \to \infty$ (Pesaran and Smith, 1995; Pesaran *et al.*, 1999).

In the presence of heterogeneity bias, there are a number of possible approaches. One option is to use the mean group estimator, estimating [1] separately for each of the N groups and deriving consistent parameter estimates by averaging the parameters across groups (Pesaran and Smith, 1995). However, the resulting estimates may not be particularly efficient especially if either T is small and a large number of explanatory variables are included, or if there are some commonalities between at least some parameters and/or variances across groups.

An alternative is to use the pooled mean group estimator proposed by Pesaran *et al.* (1999). This estimator allows the intercepts, the short-run coefficients and the error variances to vary across panel groups, but imposes common long-run coefficients.[8] In this case [2] becomes:

$$\Delta\ln(Y_{it}) = \alpha_i - \gamma_i[\ln(Y_{it-1}) - \theta\ln(X_{it})] + u_{it} \quad [4]$$

An alternative model is a pseudo pooled mean group model with common group variances and long-run parameters:

$$\Delta\ln(Y_{it}) = \alpha_i - \gamma_i[\ln(Y_{it-1}) - \theta\ln(X_{it})] + w_{it} \quad [5]$$

For models [4] and [5] only estimates of the dynamic parameter(s) (γ_i) are obtained by averaging across the individual group estimates. In both cases, intermediate versions of the models are possible, with common coefficients or variances imposed on sub-groups within the panel. It is also possible to estimate [2] with common variances imposed, but heterogeneous short and long-run parameters. As there are strong grounds for believing that the relationship between service exports and international production relocation may vary for different types of exports, we use such estimators below. Any restrictions imposed can be tested using a likelihood ratio (LR) test against the mean-group model, since this does not impose either common coefficients or common group variances.[9]

We estimate versions of [1], [2] and [5] for a panel with the six different categories of private services exports shown in Table 1 (*i.e.* N = 6). The six categories are travel and tourism, passenger fares, transportation, royalties, other affiliated (intra-firm) business services and other non-affiliated business services, all measured in US dollars at constant 1996 prices. We use annual data from 1987-2000 (*i.e.* T = 14), so that there are 84 observations in total. Travel and other non-affiliated services are the largest two categories of private services exports, each accounting for just over a quarter of total exports of services. Exports of transportation services have grown relatively slowly over time compared with other forms of services trade, with their share in total service exports almost halving over the sample period. An important point to note is that since we use balance of payments data our data set of service exports does not include the sales of US-owned foreign affiliates abroad (Mode 3 of services trade under GATS). This is also true of all the other studies of US service exports cited above.

Table 1. **Types of private services exports**
Percentages

Category of exports	Classification	Share of total exports (%)		
		1986	1993	2000
Travel/tourism	Mode 2: consumption abroad	26.3	33.7	29.5
Passenger fares	Mode 1: cross-border supply	7.2	9.6	7.4
Transportation	Mode 1: cross-border supply	19.9	12.8	10.8
Royalties	Mode 1: cross-border supply	10.5	12.6	13.7
Other affiliated business services	Mode 1: cross-border supply Mode 4: presence of natural persons	10.8	9.8	11.4
Other non-affiliated business services	Mode 1: cross-border supply Mode 2: consumption abroad Mode 4: presence of natural persons	25.3	21.4	27.3

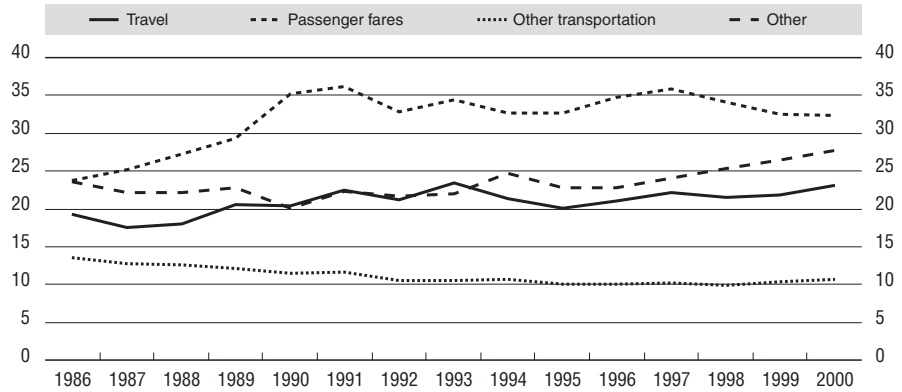
Source: Authors' calculations, *Survey of Current Business*, United States Bureau of Economic Analysis.

The vector X_{it} comprises five separate variables – the US real effective exchange rate, an industry-specific measure of foreign demand, the (constant price) relative stock of R&D in the US and two measures of international production relocation. All the variables used are in logarithms.[10]

The US real effective rate is measured as US consumer prices relative to a weighted average of the consumer prices of other OECD economies, who will be the major competitors to US exporters in world markets.[11] In the majority of cases it is to be expected that an appreciation of the real exchange rate should reduce the demand for US-produced services. Foreign demand is measured as the total global dollar value of different categories of imports of private services less US imports, using data from the IMF *Balance of Payments Yearbook*, deflated by a weighted foreign consumer price index. This provides a measure of total potential market size for US-based producers of tradable services. We use both the level and the annual rate of change in estimation. The IMF data allow private services to be split into travel, passenger services, freight and other transportation, and a fourth, residual category which includes royalties and other affiliated and unaffiliated services. Most other existing empirical studies of US service exports have used measures of foreign income, such as OECD GDP, rather than explicit measures of total import demand. See, for example, Wren-Lewis and Driver (1998) and Mann (2004). As international trade in services has risen more rapidly over time than total global income, conditioning on import demand should result in a smaller income elasticity than conditioning on foreign GDP.

Figure 1 illustrates that the profile of the share of US exports in each separate category of global imports has differed significantly since the late-1980s, suggesting that

Figure 1. **The US export share of world imports (per cent)**



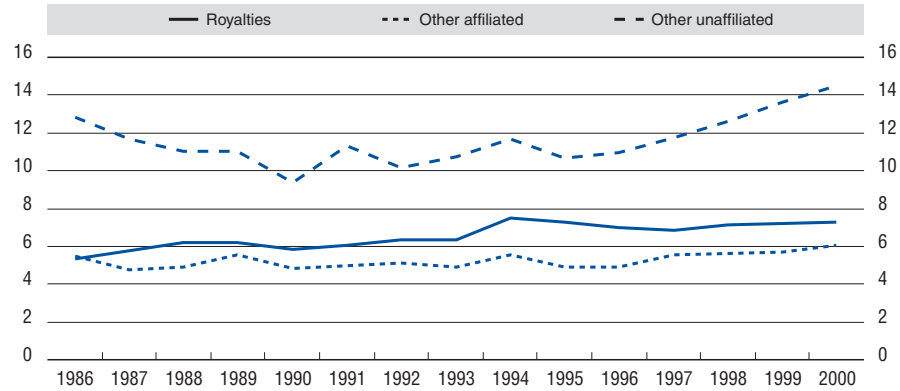
Source: Bureau of Economic Analysis and IMF Balance of Payments Statistics Yearbook.

heterogeneous effects might be found in estimation. US-based providers account for around one-third of imports of passenger services in non-US countries, but after rising sharply at the start of the 1990s the share subsequently stagnated. The first half of the 1990s also saw an improvement in the US share of travel services, whilst the latter half of the sample was notable for the improvement in the US share of the residual, non-transport, non-travel category. In contrast, the US share of other transportation services fell consistently, particularly in the late 1980s and early 1990s.

Figure 2 plots the shares of royalties, affiliated and unaffiliated services in global non-travel, non-transportation trade. Again different trends are apparent in the three series, with gradual upward trends in the shares due to royalties and affiliated services, and a much more marked jump in the share due to unaffiliated services in the latter half of the 1990s following a period of relative poor performance in the late 1980s.

For given prices, the share of global demand for services met by US-based providers is likely to depend on two factors – the relative quality of their products and the range of different products that they are able to supply, although there have been few attempts to model such factors in past empirical work on trade in services. The stock of R&D undertaken in the US relative to that undertaken elsewhere and the international location of production may affect both these factors, as argued by Pain and Wakelin (1998) and others. Innovation can be expected to influence both the range of products and firm-specific services available, as well as the likely quality of those services. The relocation of production from the US to overseas may affect the range of services that can be supplied from the US, as well as the potential demand for intra-company services.

Figure 2. **The US export share of global non-travel, non-transportation imports (per cent)**



Source: Bureau of Economic Analysis and IMF *Balance of Payments Statistics Yearbook.*

The R&D variable is defined as the stock of service sector R&D undertaken in the US relative to a total service sector R&D stock in twelve other countries. In all countries consistent data for the total flow of service sector R&D expenditures were obtained from the OECD ANBERD database and converted into constant prices using national GDP deflators.[12] A benchmark stock was created for 1973 and updated using a standard perpetual inventory model.[13] As shown in van Welsum (2003b), the resulting measure suggests that R&D rose especially rapidly in the US relative to other countries in the early 1990s, and again at the end of the decade.

To capture the impact of the international relocation of production we examine three different measures separately – the stock of foreign direct investment by US-owned companies and the sales and the gross product of US-owned foreign affiliates. All are converted into constant 1996 prices by deflating using the US GDP deflator. Each reflects different aspects of production relocation. The FDI stock measures the value of financial capital invested overseas, sales measure the gross output of foreign affiliates, thus including any intermediate services purchased from providers located in the US, and gross product measures the value added of affiliates.

FDI stocks are used frequently in cross-country analyses because of their availability. Grünfeld and Moxnes (2003) explicitly use FDI stocks as a proxy for foreign affiliate sales. However, FDI stocks may not necessarily reflect the total scale of activities carried out by foreign affiliates as they represent only a transfer of financial capital. The sales of foreign affiliates, when available, provide a comprehensive measure, but a high level of sales need not reflect a high level of affili-

ate production. Gross product provides a good measure of affiliate production, and hence the potential for activities to be relocated from the US, but does not contain direct information about any intermediate services purchased by affiliates. Detailed data on the activities of foreign affiliates is available for the United States, but is often sparse or unavailable for other countries. We investigate the impact of all three measures of international production relocation to explore the importance of the often expressed concerns about the potential mismatch between FDI data and the actual activities of multinational firms (Gestrin, 2002).

For each measure of international production relocation we test whether there are different effects from relocation in the service and non-service sectors. To illustrate how this can be done, suppose we wish to test for differential effects from services and non-services FDI, denoted FDIS and FDIN, respectively (where *FDIS* + *FDIN* = *FDIT*). Then:

$$\alpha \ln (FDIT) = \alpha_1 \ln(FDIS) + \alpha_2 \ln(1 + FDIN/FDIS) \qquad [6]$$

The hypothesis of similar effects from both forms of FDI implies that $\alpha_1 = \alpha_2$. Alternatively, [6] can be written as:

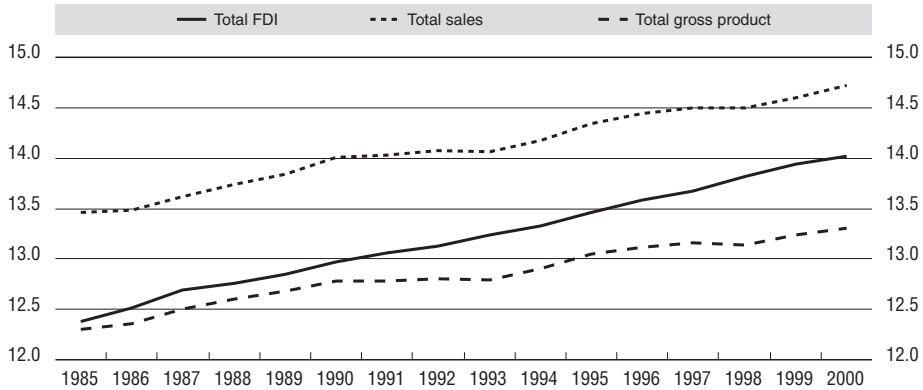
$$\alpha \ln (FDIT) = (\alpha_1 - \alpha_2) \ln(FDIS) + \alpha_2 \ln(FDIT) = \beta \ln(FDIS) + \alpha_2 \ln(FDIT) \qquad [7]$$

In this case the hypothesis of equal effects from both types of FDI implies that $\beta = 0$. We adopt this approach in the empirical work below, incorporating separate terms for total production relocation and production relocation in the service sector.

Figures 3 and 4 show the relative importance of the three measure of production relocation: FDI, affiliate sales and gross product of affiliates, using a logarithmic scale. All three measures exhibit similar trends over time, but there are some noticeable differences in their relative size and rates of change. Taking all sectors together, affiliates sales were the largest in absolute terms, but total FDI grew faster over the period 1986-2000 (Figure 3). Amongst the specific services sector measures (Figure 4), FDI was largest in absolute terms and also had the fastest rate of growth. The relative importance of production relocation in services sectors appears much higher in the FDI stock data than in the other two measures. The share of services FDI in total FDI was 19 per cent in 1986 and rose to 48¾ per cent by 2000. The shares of services affiliates in total affiliate sales and gross product were much lower both at the start and at the end of this period, at 6¼ per cent and 3¾ per cent respectively in 1986, and 13¼ per cent and 12¾ per cent respectively in 2000. These differences suggest that it is worthwhile to investigate the extent to which the empirical results are sensitive to the choice of proxy for the extent of international production relocation.

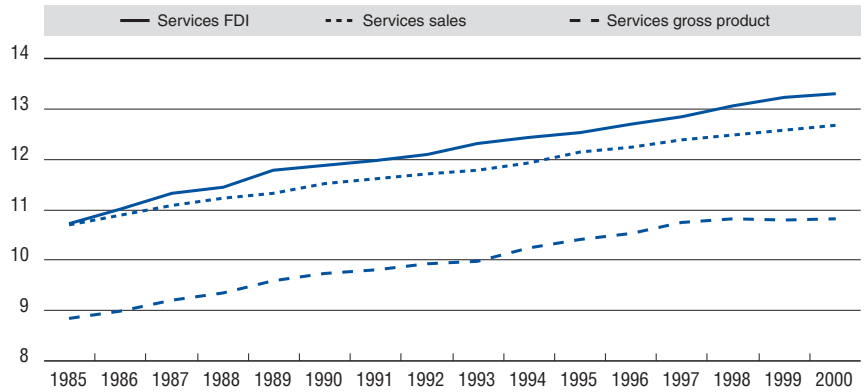
An extensive discussion of the potential relationships between production relocation and each different category of services export is provided by van Welsum (2003a and b). These papers make the point that empirical evidence is required to weigh the balance of several different competing forces, as the

Figure 3. **Total FDI stock, affiliates sales and gross product, 1985-2000**
Log scale



Source: Bureau of Economic Analysis.

Figure 4. **Service sector FDI stock, affiliate sales and gross product, 1985-2000**
Log scale



Source: Bureau of Economic Analysis.

results of Blonigen (2001) suggest. To take one example, consider transportation services. Exports of transportation services consist of expenditure on freight transportation and port services. Production relocation in this sector through the establishment of sales offices abroad might have a negative impact on exports because foreign companies can use the services of foreign subsidiaries (affiliate sales)

rather than those of US-located sales offices. But as demand for transportation services is positively related to the overall level of trade, the strengthening of international business linkages via production relocation in non-service sectors might have a positive impact on the demand for transportation services if it is associated with increased levels of merchandise trade.

ECONOMETRIC RESULTS

Initial econometric results with each of the three different measures of international production relocation are reported in Table 2. Mean group estimates (see equation [2]) are reported in columns [1]-[3] and pooled mean group estimates (see equation [5]) are reported in columns [4]-[6]. The upper rows of the table report the long-run parameters (denoted θ in [2] and [5]). The lower rows report the remaining short-run dynamic parameters and summary statistics. Fixed effects for each category of exports were included in estimation, but are not reported here.

The basic pattern of the results is similar across all specifications and estimation techniques. In general, the equilibrium-correction parameter (denoted γ_i in [2] and [5]) is well determined, suggesting the presence of a valid (cointegrating) long-run solution. Export volumes are positively related to demand, both in the short-run (market growth) and in the long-run, and negatively related to the real exchange rate. The size and the significance of the long-run demand and relative price effects are noticeably larger in the pooled mean group estimates, with the elasticities being well above unity and comparable to those found by Pain and Wakelin (1998) for merchandise trade. In contrast, there is little evidence of any significant effect from the relative R&D variable, and in five of the six models the estimated parameter is negative.

The different indicators of multinational activity have broadly similar effects. In the mean group specifications the coefficients are largely positive, but individually insignificant. In the pooled mean group models the coefficients are also individually insignificant, but the point estimates are now predominantly negative. Affiliate sales appear to be the most suitable choice of measure in the mean-group estimates, as this specification has in terms of both the log-likelihood and SBC values, but in the pooled mean-group results, the FDI stock produces the "best" fitting model. However, the strongest evidence of a negative effect from FDI emerges in the pooled mean-group specification with the gross product of affiliates. In this model the two FDI terms are jointly significant (p-value 0.009).

The impact of service sector affiliate activity on exports appears much more negative when gross product is used than when affiliate sales are used. One possible explanation for this is that the sales of services affiliates include intermediate

Table 2. **Determinants of exports of services**

Dependent variable: $\Delta \ln(X_{it})$, sample period: 1987-2000

	Mean group			Pooled long-run		
	[1]	[2]	[3]	[4]	[5]	[6]
Long-run parameters						
Demand	0.708 (1.9)	0.785 (1.3)	0.980 (1.4)	1.350 (8.2)	1.648 (7.2)	1.871 (10.9)
Relative prices	–0.989 (1.2)	–0.694 (1.8)	–0.598 (1.3)	–1.337 (3.6)	–1.571 (4.1)	–1.402 (5.0)
Relative R&D	–0.179 (0.7)	–0.028 (0.3)	0.019 (0.1)	–0.130 (0.9)	–0.300 (1.8)	–0.191 (1.7)
Total FDI	0.218 (0.4)			–0.409 (1.0)		
Services FDI	0.047 (0.3)			0.247 (1.0)		
Total affiliate sales		0.090 (0.3)			–0.126 (0.4)	
Services affiliate sales		0.105 (0.4)			–0.014 (0.1)	
Total gross product			0.146 (0.7)			–0.135 (0.5)
Services gross product			–0.001 (0.0)			–0.182 (1.7)
Dynamic parameters						
Market growth	0.443 (2.7)	0.588 (2.2)	0.538 (2.3)	0.428 (3.7)	0.594 (4.4)	0.610 (5.0)
Equilibrium correction	–0.764 (3.1)	–0.859 (4.0)	–0.867 (4.4)	–0.423 (4.3)	–0.439 (9.6)	–0.493 (10.1)
Log-likelihood	208.84	221.97	199.63	152.34	148.05	148.73
SBC	89.21	102.34	80.00	99.17	94.88	95.56
R^2				0.567	0.521	0.536
Standard error				0.0471	0.0496	0.0487

Note: Heteroscedastic t-statistics in parentheses. Hausman test of random *versus* fixed effects models.

services purchased from the parent company, whereas value-added in those affiliates is more likely to occur as an alternative to value-added in the parent company.

It is also of interest to note that whilst the log-likelihood measure indicates a clear preference for the mean-group estimator, which might be expected with parameter heterogeneity, the SBC statistic is less conclusive. This reflects the extent to which the mean-group estimator is penalised for the inclusion of far more parameters in estimation, some of which are insignificant.

The restrictions required to move from the mean group estimates to the pooled long-run, pooled variance estimates are heavily rejected by the data on the basis of a likelihood ratio test, as shown by the associated p-values reported in the first row of Table 3. It is possible to test these restrictions separately by estimating another model with pooled variances but without pooled parameters, and using the log-likelihoods from this model and the mean-group model to test the imposition of common variances only. The resulting p-values are shown in the second row of Table 3. In each specification the five (N-1) restrictions on the mean-group model are jointly accepted by the data. The acceptance of common variances, but rejection of common long-run parameters points strongly to the existence of parameter heterogeneity across the different categories of service exports, as suggested by the profiles of market shares in Figures 1 and 2. This conclusion is further reinforced by the finding that, whatever measure adopted, the parameters on the two multinational activity variables are jointly significant in the model with pooled variances only.

Table 3. **P-values of joint hypothesis tests**

Test	Indicator of production relocation		
	FDI stock	Affiliate sales	Gross product
Pooled variances and long-run	0.000	0.000	0.000
Pooled variances	0.903	0.297	0.197
Time dummies	0.069	0.005	0.000

Note: p-values of likelihood ratio tests of joint imposition of common variances plus common long-run parameters; common variances only; joint deletion of time dummies.

The models in Table 2 include a number of variables which vary across time, but not across different categories of services. It is natural to ask whether these variables capture all relevant time-varying factors common to all types of service exports. To investigate this, a set of annual time dummies were added to the pooled mean-group models.[14] The p-values from tests of the joint significance of the time dummies are reported in the bottom row of Table 3. In two models the time dummies were jointly significant at conventional levels, and in the third, the

model with the FDI stocks, they are significant at the 10 per cent level. Thus all the remaining results reported in this paper are taken from regressions that include time dummies.

Illustrating the Heterogeneity Issue

The results reported above suggest that there may be considerable parameter heterogeneity across service sectors and that the results obtained are sensitive to the choice of estimation technique. To illustrate the importance of allowing for parameter heterogeneity we use the pseudo pooled mean group model with affiliate sales and time dummies. In the unrestricted version of this model with common error variances but no common coefficients a number of the individual parameters were not particularly well-determined, possibly reflecting the small sample size. But there was clear evidence of significant effects from multinational activity on service exports, as the twelve parameters on the affiliate sales variables were jointly significant [LR(12) = 73.41]. In the majority of export categories the coefficient on total affiliate sales was positive, whilst that on service affiliate sales was negative. Taken together, this suggests that international production relocation in non-service sectors is more likely to provide a positive stimulus to services exports than is relocation in service sectors. One additional feature of interest from the unrestricted model was that the coefficient on relative R&D was now positive for all categories of exports, varying in magnitude and significance. This is in marked contrast to the results reported in Table 2 when common coefficients are imposed invalidly.

As was the case in the models reported in Table 2, the restrictions required to impose common long-run parameters on the unrestricted model continued to be jointly rejected [LR(25) = 96.18]. However it was possible to gain greater precision on the reported parameters by imposing a subset of data-acceptable restrictions on the long-run coefficients [LR(15) = 7.60; p-value = 0.938]. The resulting restricted long-run coefficients (or equivalently, elasticities) are reported in Table 4.

Significant positive demand coefficients are obtained for all categories of exports, with common coefficients imposed for both travel and unaffiliated services (0.602), and for the other transportation and affiliate services categories (0.414). Considerably larger elasticities are obtained for passenger fares, suggesting that export volumes are very sensitive to fluctuations in global demand, and also royalties. Evaluated using the sample mean shares of each export category in total services exports, the weighted aggregate long-run demand elasticity is 1.014. So if world demand for all types of services rose by 1 per cent, US export volumes would eventually rise by 1.014 per cent, other things being equal.[15] Implicitly, the remaining factors in the model – relative prices, R&D, affiliate sales and time dummies – are therefore providing an explanation for fluctuations in the aggregate

Table 4. **Illustration of parameter heterogeneity: restricted long-run parameters**

	Travel	Passenger fares	Other transportation	Royalties	Other affiliated services	Other unaffiliated services
Demand	0.602 (6.8)	4.486 (7.8)	0.414 (6.1)	1.445 (4.1)	0.414 (6.1)	0.602 (6.8)
Relative prices	–0.513 (7.5)	–0.812 (7.3)	–0.513 (7.5)	0	0	0.812 (7.3)
Relative R&D	1.175 (6.9)	0.706 (8.2)	0.152 (3.3)	1.723 (4.8)	0.553 (8.8)	0.706 (8.2)
Total affiliate sales	0.572 (5.0)	0.225 (4.2)	0.225 (4.2)	–1.921 (3.1)	0.225 (4.2)	–0.225 (4.2)
Services affiliate sales	–0.572 (5.0)	–1.583 (7.7)	–0.118 (6.1)	0	0.118 (6.1)	0.118 (6.1)
$R^2 = 0.892$; Standard error = 0.0235; Log-likelihood = 227.04.						

Note: Heteroscedastic-consistent t-statistics in parentheses.

Table 5. **Elasticities (per cent; standard errors in parentheses)**

	Travel	Passenger fares	Other transportation	Royalties	Other affiliated services	Other unaffiliated services
Services affiliate sales	–0.496 (0.099)	–1.553 (0.204)	–0.088 (0.018)	–0.255 (0.084)	0.148 (0.023)	0.088 (0.018)
Non-services affiliate sales	0.496 (0.099)	0.195 (0.045)	0.195 (0.045)	–1.666 (0.545)	0.195 (0.046)	–0.195 (0.046)

Note: Elasticity of services exports with respect to each type of affiliate sales using results in Table 4.

US share of global services trade over time. These results appear broadly consistent with the findings of income elasticities greater than unity in other empirical studies such as Wren-Lewis and Driver (1998), Ansari and Ojemakinde (2003) and Mann (2004), given that world imports of services have tended to rise faster than global incomes over time.[16]

A rise in the relative R&D stock is now found to have a significant positive long-run effect on all categories of exports, suggesting that product innovations in the service sector ultimately help to raise export levels. As might be expected, the largest impact of the R&D measure is found for receipts of royalty payments, with the long-run elasticity being 1.7 per cent. Such payments are likely to be closely linked to the level of firm-specific assets owned by US companies.

There are marked differences in the real exchange rate coefficients across categories of exports. A rise in the real exchange rate has a significant negative effect on three categories of exports – passenger fares, travel and other transportation exports. The latter two have a common price elasticity of demand of –0.51 per cent, with passenger fares having a higher elasticity of –0.81 per cent. In contrast, a significant positive real exchange rate effect is found for other unaffiliated services, implying that a real exchange rate appreciation will stimulate this form of exports, other things being equal. One possible explanation for this result is that exporters of these types of services compete primarily on the basis of product quality (and reputation) rather than price, with a rise in relative prices taken as a signal of a rise in relative quality. The coefficients on the real exchange rate were found to be insignificant in two categories of exports – royalties and other affiliated services, and were set to zero. Intra-firm transactions are unlikely to be affected heavily by real exchange rate fluctuations, given the scope for multinationals to engage in transfer pricing.

Weighted across categories of services the aggregate long-run relative price elasticity in Table 4 is just –0.11 per cent. The finding of a small aggregate price elasticity appears consistent with the results of other studies, see for example Mann (2004). Our results provide an explanation for this aggregate empirical regularity by illustrating that it arises from the heterogeneous nature of different categories of exports, rather than being a factor common to all types of services.

Significant parameters are obtained on the affiliate sales variables in each category of exports. In all categories, with the exception of royalties, the impact of a change in the sales of service sector affiliates is significantly different from a change in the sales of non-service sector affiliates. This is illustrated in Table 5, which contains the implicit long-run elasticities for affiliate sales in services and non-services, calculated using their shares in total affiliate sales in 2000, along with the associated standard error.[17]

The results illustrate that the relationship between international production relocation and exports is likely to vary across different types of exports, as well as according to the sector in which relocation takes place. In four out of six categories a rise in the sales of service sector affiliates will ultimately have a negative effect on exports of services, with the largest negative effects being found for travel and passenger fares. Only in the case of other affiliated and unaffiliated business services does greater production relocation in the services sector appear to have a positive impact on exports, given market size. In contrast, a rise in the sales of non-service sector affiliates is estimated to have a positive effect on four of the six categories of service exports, as would be predicted by models of multinational firms that emphasise the role of headquarter services (Helpman, 1984; Markusen, 2002). Exports of other affiliated services is the only category of services in which exports are stimulated by a rise in affiliate sales in both the service and non-service sectors, suggesting that international production relocation stimulates intra-firm trade in services.

A feature of the results which may merit further investigation is that receipts of royalty payments are found to be significantly negatively related to higher affiliate sales in both service and non-service sectors. One possible explanation might be that, over time, affiliates have taken over the licensing of firm-specific assets to third parties that was originally undertaken by parent companies, with the latter receiving remitted profits rather than direct payments of royalties.

The diversity of effects found across different types of services means that the aggregate impact of international production relocation on service exports from the United States may be small, even if there are large effects on individual categories. Using the sample mean shares of each category of exports in total exports, the weighted aggregate elasticities on non-service and service affiliate sales are –0.05 per cent and –0.30 per cent respectively. Excluding royalties, the weighted elasticities are plus 0.20 per cent and –0.31 per cent.

CONCLUSIONS

In this paper we have sought to investigate the time series relationship between foreign direct investment and exports of services using detailed data on different types of service exports from the United States. Our main focus has been on whether international production relocation subsequently affects export performance. In a time series context, this is a more appropriate question than the usual approach of asking whether FDI and exports of services are complements or substitutes.

Our results suggest that the relationship is sensitive to the empirical specification in general, and to the measure of demand employed in particular. When using industry-specific world imports we find that for most categories of services

there is a positive relationship between exports and outward production relocation in non-service sectors after allowing for the impact of changes in world demand and the relative price of US exports. However, the relationship with services FDI is, on the whole, found to be negative. Weighting these together, the overall impact of all forms of international production relocation on services exports from the United States is likely to be slightly negative.

Once allowance is made for heterogeneity, we find significant differences in income and price elasticities across categories of exports. The weighted average demand elasticity across all categories of services is found to be just over unity. As our measure of demand is world import volumes of services, rather than an indirect measure such as GDP or industrial production, the remaining factors in the model can be seen as ultimately determining the US share of world trade in services. Both price and non-price factors are found to be important. As world import volumes have risen more rapidly than world incomes over time, our results confirm the common finding that the global demand for traded services is income elastic.

A second feature of the results that allow for heterogeneity is that they provide an explanation for another finding common to most empirical studies of US service exports, namely a low relative price elasticity. Although some types of services are negatively related to the real dollar exchange rate, it has little or no influence on intra-firm trade in services, and has a positive impact on one category of exports, other private unaffiliated business and technical services. The factors behind these differences await further study.

Our paper does not focus directly on the issue of the "offshoring" of service sector activities, a topic that has received considerable recent attention in the United States and elsewhere (OECD, 2004; Brainard and Litan, 2004; van Welsum, 2004). Offshoring and the internationalisation of production are not equivalent concepts, although there are some clear overlaps. Offshoring is commonly understood to refer to the international sourcing of activities that were previously undertaken within national borders. This can be internal to the firm, with production being transferred to foreign affiliates, or external to the firm, with production being transferred to independent third parties abroad. Internal offshoring of activities is included in the US-owned affiliate production data we use, but external offshoring is not. Equally, the affiliate production data include cross-border purchases of, and investments in, affiliate companies undertaking activities that were not previously undertaken within the United States by the patent company. In such cases direct offshoring has not taken place at all.

Nonetheless, our paper does contain some findings that contribute to an improved understanding of the potential effects of offshoring. For instance, it is clear that there are circumstances in which international production relocation can have direct effects on the mix of activities undertaken in the home economy.

Other things being equal, the impact of enhanced cross-border service sector investment is to reduce the growth of home country exports relative to the growth of world markets. The cross-border relocation of production for third country markets has received little attention to date in the consideration of service-sector offshoring. Our results suggest also that the effects of offshoring can be expected to differ across different types of service sector activities, depending upon the types of activities that are moved and the additional demand that might be generated for home country services from the newly-established foreign affiliates.

Notes

1. A related model of the economic determinants of service imports into the United States is presented in van Welsum (2004).
2. The provisional FDI data for 2003 were downloaded from the Bureau of Economic Analysis website at: *www.bea.gov/bea/di/usdpos/pos_03.htm*. The service sector share of the activities of US owned foreign affiliates is smaller than the share of the FDI stock, as we discuss below.
3. This classification is also adopted in the *Manual on Statistics of International Trade in Services*, agreed to by the United Nations, the International Monetary Fund, the OECD, the World Trade Organisation and the European Commission. An alternative, but closely related, classification can be found in Stern and Hoekman (1987). Van Welsum (2003a) provides a detailed discussion of the definition, classification, and measurement of trade in services.
4. Comprehensive overviews are provided in WTO (1996), Pain and Wakelin (1998), Gestrin (2002) and van Welsum (2003b).
5. Ansari and Ojemakinde (2003) report income and relative price elasticities of 1.37 per cent and –0.42 per cent, respectively.
6. This corresponds with the sum of three separate categories in our model – royalties plus other affiliated and unaffiliated services.
7. See also Mann (2004). The other private services category used by Mann differs from that in Huang and Viana, as it does not include royalties and licence fee payments.
8. Pesaran *et al.* (1999) justify this approach by arguing that the short-run parameters are more likely to be heterogeneous in panel time series than the long-run parameters, which ultimately are tied down by factors such as budget or solvency constraints, arbitrage conditions, or common technologies.
9. We also make use of the Schwartz Bayesian Criterion (SBC) when comparing models. The SBC takes account not only of the log-likelihood of the model but also the number of freely estimated parameters, penalising the estimation of additional parameters. The number of free parameters in our calculations of the SBC includes the number of variances. This is of particular importance for panel models where either 1 or N variances may be estimated. Models that maximize the SBC will be preferred.
10. The basic model was also augmented by two outlier dummies to prevent individual observations having a significant influence on the remaining parameters, see van Welsum (2003b) for further details.
11. In 1999 for instance, industrialised economies accounted for 73.3 per cent of global service exports, with the US accounting for just over one-quarter of all exports by industrialised countries (IMF *Balance of Payments Statistics Yearbook* 2000). Separate price deflators

are available for different categories of exports in the US National Income and Product Accounts, but since it is difficult to obtain such series for competitors, we do not make use of this data here.

12. Classification changes mean that it difficult to obtain consistent time series data for separate service industries.

13. Benchmark stocks for country *i* (S_{i0}) were obtained using the approximation formula $[S_{i0} = R_{i0}/(gi + \delta)]$, where g_i is the average annual logarithmic growth rate of R&D expenditures over 1973-99, δ is the annual depreciation rate, which was assumed be 11 per cent following Carson *et al.* (1994), and R_{i0} is the initial observation on the flow of R&D.

14. More precisely, we include T-M-1 year dummies, where M denotes the number of included variables that vary over time but not across panel members, in order to avoid perfect colinearity. A further dummy is excluded to avoid perfect colinearity arising from the inclusion of separate fixed effects for each category of exports. The standard error of the model is invariant to which time dummies are dropped.

15. As noted above, this result can be reconciled with the higher income elasticities found in other models of US service exports because the latter use measures of world income rather than a direct measure of world import demand. Import volumes have risen faster than incomes over time.

16. Over the sample period used here, our data show an average annual increase of 4.7 per cent per annum in total world trade in non-government services at constant prices, compared with an average annual growth in world GDP of approximately 2.8 per cent. So the weighted demand elasticity we obtain of 1.01 per cent implies that the income elasticity is around 1¾ per cent.

17. The elasticity of exports with respect to service affiliate sales is given by $\alpha_2[AFFS/AFFT] + \beta$, and the elasticity with respect to non-services affiliate sales is given by $\alpha_2[1 - (AFFS/AFFT)]$, where α_2 and β are the long-run coefficients on total affiliate sales (AFFT) and services affiliate sales (AFFS) in Table 4.

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