WPS5155

Policy Research Working Paper 5155

The Impact of Trade in Services on Factor Incomes

Results from a Global Simulation Model

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The World Bank
Development Research Group
Trade and Integration Team
December 2009

Policy Research Working Paper 5155

Abstract

Indian gross domestic product per capita increased rapidly between 2001 and 2006 in a climate of increasing services trade, with the export-oriented services sector responsible for rising shares of growth in gross domestic product. Due to its contribution to aggregate economic growth, there is a great need for empirical examination of the distributional consequences of this growth, especially in light of the challenges in obtaining theoretical solutions that can be generalized. This paper fills this gap in the literature by using a global simulation model to examine how sensitive factor incomes across different industries may have been to the historical changes in India's services exports and imports, and provides insight on the distribution of the national income growth attributable to the expansion of the services industry. Rent on capital in the service sector and wages of all workers would have increased as a result of greater services trade in this period, while income from capital specific to agriculture and manufacturing would have declined. The factors involved with the urban-based services sector may thus benefit from the services trade growth, while the total factor income involved in rural agriculture may decline.

This paper—a product of the Trade and Integration Team, Development Research Group—is part of a larger effort in the department to improve our understanding of the trade in services. Policy Research Working Papers are also posted on the Web at http://econ.worldbank.org. The author may be contacted at sahmed20@worldbank.org.

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Produced by the Research Support Team

THE IMPACT OF TRADE IN SERVICES ON FACTOR INCOMES: RESULTS FROM A GLOBAL SIMULATION MODEL

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Keywords: General Equilibrium, Mode 1, Services, India, Outsourcing

JEL: C68, F15, F17

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1. Introduction

The past decade or so has seen globalization and advances in technology expand the volume and importance of the trade in services. With the services sector comprising two-thirds of GDP in many industrialized economies, this has greatly enlarged the potential for labor market impacts. Within the policy framework of the General Agreement of Trade in Services (GATS), this direct trade in services can occur as the cross-border trade in arm's length services – Mode 1[2] trade – where services are considered to be traded when a supplier in one country provides services to a demander in another country.

The need for a rigorous and clear analysis of this direct trade in services – often referred to as outsourcing, as in this paper – has risen in proportion to the plethora of work on the topic that relies on varying definitions of outsourcing, with equally varying theoretical foundations. Fragmentation of the production process has allowed many services to become not just separable from previously integrated production processes of higher value goods, but also tradable. As Bhagwati et al (2004) points out, a defining characteristic of the current services outsourcing phenomenon is that previously nontradable services have become tradable through technology-induced fragmentation. Examples include call center support, software development, and miscellaneous back office operations.

In the context developing countries and outsourcing, India is the most high profile exporter of services to developed countries, where outsourcing is considered an important driver of economic development. Viewed as a challenge to popular growth theories, India's service-exporting economy has grown despite the absence of export competitive agriculture and high-end manufacturing, two sectors typically considered to be precursors of an economy that is heavily dependent on a robust services sector (Stough et al, 2005). During the 1990s, Indian exports of services grew significantly faster than the domestically oriented sections of the service sector, with the Indian share of world services exports growing from 0.55 percent to 0.65 percent between 1980 and 1997 (Chadha, 2001).

India has also increased its imports of Mode 1 services from the rest of the world rise. As a result of increased trade in an ever-expanding set of services that are used as intermediate inputs, factor use intensities – the ratio of an input quantity to output quantity – within Indian industries are changing.

[2] Defined in General Agreement of Trade in Services Articles I.2 (a) and XXVIII (b) as the "the production, distribution, marketing, sale, and delivery of a service by a service supplier from the territory of one Member to the territory of any other Member" (GATS).

Unfortunately, the impacts of these changes on the labor market are analytically difficult to predict. On the face of things, increased trade in intermediate input services may be thought to reduce employment in an importing country. However, if workers are employed in a firms' production processes further up in a value chain – such as in management or sales – the use of service imports as intermediate inputs may reduce firms' costs, thereby permitting expansion of the sector as well as possibly upgrading skills and wages for existing workers. There is thus a possibility that increasing Mode1 imports into India, may be beneficial to Indian industries

There is also a need to better understand the mechanisms by which the economic benefits (or losses) of the service exports and imports filter through to the rest of the Indian population – the majority of whom are not involved in this increasingly higher wage sector. There have been very few analyses of the welfare and income implications for India of increased outsourcing, and no explanation of the mechanisms through which these changes would occur. In the absence of comprehensive strategic planning, economic development that relies on an export-oriented services sector and its possible secondary effects may inadvertently ignore other areas of opportunity, such as agriculture and manufacturing. According to IFAD (2008), three out of four of India's poor are in the agriculture-focused rural areas. A more balanced perspective of the distributional consequences of services growth may recognize that the outsourcing boom does not benefit everyone in India, and that it may contribute to a widening development gap between factors in different sectors.

Addressing the gaps in the literature on the relationship between the services trade and development, this paper thus aims to answer the question: How have the income gains from greater Indian services exports and imports been distributed across factors in different industries between 2001 and 2006? It will do so by drawing on a set of stylized facts about the Indian economy to set up and calibrate a global simulation model built on specific-factors (Ricardo-Viner) theory. Then under the assumption that the observed changes in skilled labor have been driven solely by the services trade, it will examine how sensitive the changes in prices of other factors have been to rising imports and exports in India. By assuming that all the wage effects are driven by the services trade growth, ignoring possible contributing forces in other industries and the labor market, the price and wage results can be considered to be at the upper bound of the potential impacts of greater services trade.

Section 2 will review the historical context of Mode 1 services in India, while Section 3 describes the theoretical foundations that the discussions of services trade have been based on in the literature. Section 4 describes the applied general equilibrium methodology to be used and Section 5 analyzes the results. Concluding remarks are made in Section 6.

2. The Indian Context

India has demonstrated rapid economic growth over the first half of this decade, clocking in an annual real GDP growth rates of more than six percent between 2001 and 2006, increasing the GDP per capita (PPP) from US$ 2513 to US$ 3736 (IMF 2007a). Much of this growth has been attributed to the export-oriented services industries. This reputation can be attributed to service industries like information technology (IT), which was alone responsible for 3.8 percent of GDP in 2003-04, up from 1.22 percent of GDP in 1997-1998, as reported by Thatchenkery et al (2005). Based on these contributions of services to aggregate growth, some studies (Stough et al, 2005; Bhatnagar, 2003) argue that the growth of services, such as information communication technology , have allowed for a "leapfrogging" effect in Indian development, where India has been able to bypass the traditional development paradigm of developing agricultural and manufacturing industries before an export-oriented services sector. The rapid Indian growth over this period is certainly concurrent with the increases in Indian services exports.

Based on data from the IMF's Balance of Payments Statistics (2007b), Indian services exports grew at an average annual rate of about 34.45 percent between 2000 and 2006, allowing for exports to grow by 477 percent over the period (Figure 1). Over this period, the services exports increase was mirrored by a 280 percent growth in the services imports, although India was able to maintain a growing services trade surplus (Figure 1). As of 2001, 93 percent of these Mode 1 imports were demanded by the services sector[3], illustrating their importance to India's own services-export sector. The manufacturing and agricultural sectors demanded the remaining 6 percent and 1 percent of Mode 1 imports, respectively.

[3] Based on balanced data extracted and balanced from Dimaranan (2006), provided in Table A-1 (Appendix A), and discussed in Section 4.2. While the share of imported services used in the production of Indian services may seem very high, it should be noted that it does not reflect the shares of domestically produced service inputs or total services inputs (domestic and Mode 1) used by the industries. The services and manufacturing industries use 46 and 37 percent of domestically produced services inputs, respectively. Looking at total services (domestic and Mode 1) inputs used the services and manufacturing industries use 48 and 37 percent of the total. Mode 1 services inputs are thus a very small share of all service used as intermediate inputs in India.

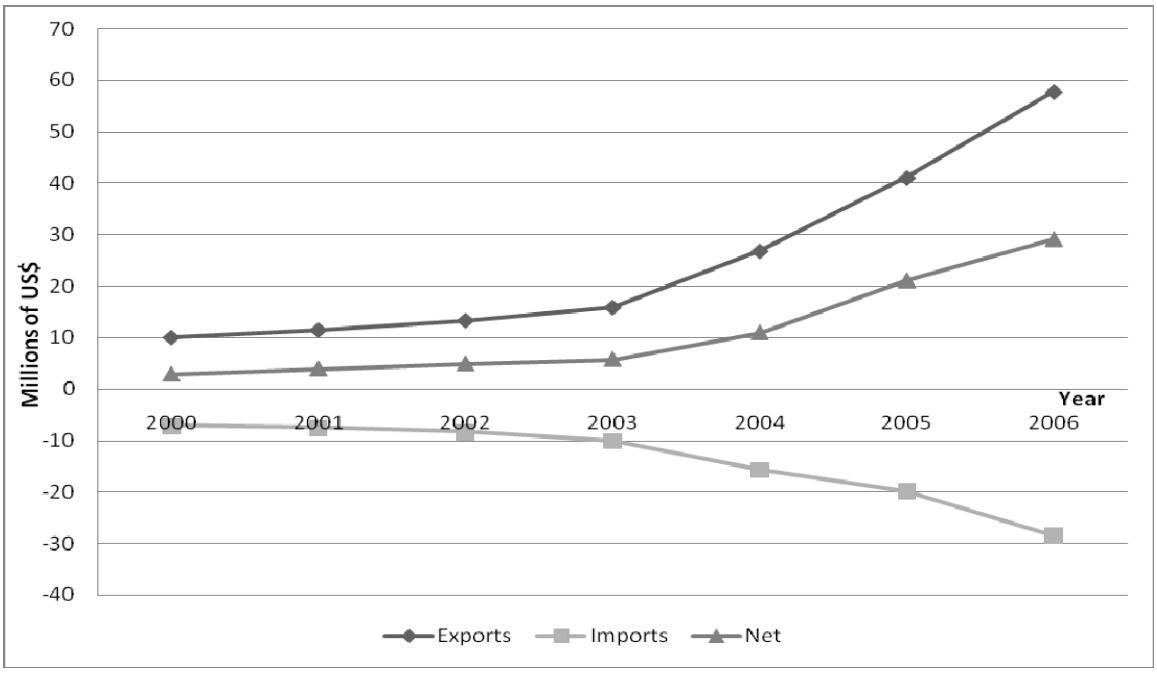


Figure 1 Indian Trade in Millions of US$ (2000-2006)

Source: IMF (2007b)

Note: Services here collectively refers to communication, insurance, financial, computer and information, and other business services, as defined in the IMF's Balance of Payments

However, it is difficult to analyze the impact of the services trade growth on Indian development. Analyses are obfuscated by the liberalization of the Indian economy vis-à-vis foreign direct investment (FDI). Since 1991, the previously heavily protected Indian economy has liberalized significantly, with several policy initiatives being taken to encourage FDI (Singh, 2005). While about a fifth of the FDI between 1991 and 2006 has gone into telecommunications and other services sectors, the remainder has gone into manufacturing and agriculture (MCI India, 2005). Given that the services sector accounts for more than half the total Indian output, the uneven distribution of investment and the record increases in FDI complicate the precision of analyses of the services trade's indirect effects on other sections of the Indian economy.

Aside from the complications in analysis introduced by the concurrent liberalization of FDI, there are distributional issues associated with how the gains from services exports are distributed across the Indian economy. Most of India's labor force works in agriculture, and the linkages between the services and agriculture sectors are not well understood. As several empirical studies have found, sustainable development through agricultural growth is more promising for rural poverty reduction than approaches that hinge on industrial growth (Timmer,

1997; Ravallion and Chen, 2007; de Janvry and Sadoulet, 1996). The impact on non-service sectors like agriculture and manufacturing which have traditionally been the foci of pro-poor economic growth strategies, are thus at risk of being implicitly understated by the glamour of the services sector. There is also the Dutch disease problem, with the rapidly expanding export-oriented services sector driving up the exchange rate, and making other industries – such as agriculture – less competitive on the international market.

3. Theoretical Foundations

Bhagwati et al (2004) identifies an important feature of the current services trade phenomenon that makes it qualitatively different from the goods trade – the fact that the services currently being traded were previously nontradable. It is only after technological innovations that nontradables have become tradable, with the evolution of nontradable services to tradable services being theoretically linked to the fragmentation[4] of production. Services like back office operations and accounting were previously integrated components of production. However, due to technological advances, the services can now be provided by another producer and used as an intermediate input in production. Fragmentation of production can thus be considered a necessary condition to the tradability of a service.

Fragmentation in a classic Heckscher-Ohlin (H-O) model is a useful starting point to understand some of the basic mechanisms by which vertical specialization has led to the trade in services. It is known from Deardorff (1994) that for an integrated world economy (IWE), factor price equalization (FPE) will occur if the world's factor endowment lens[5] is completely inside the factor use lens[6]. So, if initially the distribution of endowments was such that the factor endowment lens had points outside the factor use lens, then there is no guarantee that factor prices would be the same across the IWE. In the two-region, two-factor, and two-good H-O model used in Deardorff (2001a), fragmentation is shown to expand the set of ways that factors can be used – and increase the possibility of FPE since there would be fewer endowment points that would be outside the factor use lens.

The intuition here is that different countries have varying factor abundances, where factor prices in each country reflect their relative abundances and how the factors are used for

[4] This is synonymous with the term vertical specialization, which describes the breaking of a single production process into separable production processes that can occur in distinct stages.
[5] This is the set of vectors that is composed of some or all of the factor endowment vectors.
[6] This is the set of vectors defined by the usage of the factors.

production. With a specific endowment distribution between the two countries, if the factors are used in a certain way, and if trade is possible, then factor prices can potentially be the same across countries. This is the case when the endowment point – the distribution of endowments between the two economies – is within the set of vectors describing how the factors might be used by the two countries. The prices prevailing would be the prices of the integrated world economy. If the factors are allocated in a way that puts them outside this factor use lens, then the returns on the factors in each country will be different. Fragmentation allows the factor use lens to adjust so that one country can take advantage of lower cost factors in the other, with the factor returns adjusting accordingly.

The framework thus described by Deardorff (1994, 2001a) can now be used to characterize outsourcing as the trade in services. Going back to the H-O model, the two factors could have been skilled workers and capital, with the two countries being India and the USA. Suppose one of the fragments in the H-O model were skilled worker-intensive services, then fragmentation would allow the service-fragment to be performed in India where labor is relatively more abundant and where wages are relatively lower than in the USA. Fragmentation would therefore allow the USA to use the Indian labor until the wages in the two countries became the same. At that point, the countries would be indifferent between workers from either country. A Hewitt Associates study cited in the New York Times reported that between 2003 and 2005 average wages in the Indian IT/ITES sector grew by 15 percent, higher than any other IT sector in the Asia-Pacific region (New York Times, 2004), and consistent with the theoretical prediction that wages in the service exporting country would rise as more outsourcing takes place.

Unfortunately, there are several challenges to obtaining clear solutions to the determination of how factor prices and factor uses vary as trade in services (i.e. outsourcing) increases. Deardorff (2001b) has shown that solutions from simple H-O models of fragmentation do not hold when subject to generalization, since the impact of fragmentation on relative factor prices is sensitive to the factor intensities of the fragments as well as the original production technology. More importantly, when fragmentation fails to cause factor price equalization, there is no guarantee that the factor prices will move closer together, and may in fact move further apart[7].

[7] Kohler's (2001) thorough review of the literature emphasizes the weakness of the H-O model in determining factor price effects when considering many goods, many factors, or many countries.

Analytical solutions that accurately delineate the real world economy are thus difficult to obtain since the problem formulation would need too many dimensions – more countries, sectors, and factors – to be able to solve with any ease or confidence.

In addition to the difficulties in obtaining clear analytical solutions, the power of services trade to move wages and factor use patterns are undoubtedly also influenced by non-tariff trade frictions. Unlike the goods trade, there is no easily measured "transportation" cost for services. However, as shown by Grossman and Rossi-Hansberg (2008), there is a cost to outsourcing a service, with the cost depending on how difficult it is to fragment production and trade the fragments. For Mode 1 services, the barriers to trade are the limitations of the technology available, such as the resolution of the digitization software or quality of the internet connection for electronic data transfers. If the technology improves, then we would expect an increase in the volume of Mode 1 services trade. There may also be non-tariff trade barriers (NTBs) like information protection legislations and accounting standards that may increase the cost of "transporting" Mode 1 services.

There is thus an absence in the literature of any generalized analytical solutions. While several empirical studies have used econometric methods to examine the historical impacts of outsourcing on the USA (see Feenstra and Hanson, 1996; Amiti and Wei, 2005, 2009; Canals, 2007), there have been no equivalent studies to shed light on the impacts of outsourcing on India. A reason for the absence of such statistical analyses of outsourcing impacts in India is that of data limitations. The USA-focused studies were able to leverage highly disaggregated panel data for specific industries and inputs from a variety of sources, such as the Annual Survey of Manufacturers and the Current Population Survey. While the data that are collected on India, by both public and private organizations are considerable (e.g. the annual Manpower Profile India yearbooks from the Institute of Applied Manpower Research), these data are inappropriate for statistical analyses in the tradition of Feenstra and Hanson (1996).

A computable general equilibrium simulation analysis calibrated on sparse, yet real world, data can fill these gaps, and provide a numerical solution of how prices and factor uses in India may adjust to increased Mode 1 services exports resulting from technological improvements[8]. This paper provides such an analysis and a better understanding of the sensitivity of factor incomes in India to the services trade.

[8] Markusen (2006) successfully used simple stylized simulation models to explain a variety of theoretical foundations perspective on outsourcing.

4. Methodology

4.1. The General Equilibrium Approach

The comparative static model used to facilitate analysis in this paper is an Arrow-Debreu type general equilibrium model based on a specific factors approach. The problem is set up in the MPSGE framework of Rutherford (1999) as a mixed complementarity (MCP) problem in sets of three variables. The three variables are: non-negative prices for goods and factors, non-negative activity levels associated with the production sectors and an income variable for the integrated world economy's household – an amalgamation of governments and representative private households. Equilibrium in the model will then satisfy a system of non-linear equations which will include market clearing, zero profit, and income balance conditions[9].

The scope of this paper will be restricted to three final goods sectors (agriculture, manufacturing, and services), and five factors of production (three types of sector specific capital, skilled labor, and unskilled labor). Two regions will be considered: India and the Rest of the World. The analytical focus will be on the impact on India of increasing its Mode 1 services exports, regardless of destination. This aggregation provides enough detail to capture the most relevant general equilibrium effects, while trimming the number of extraneous results that would complicate the analysis.

The utility and production functions are all of the constant elasticity of substitution (CES) functional form. The products of the three sectors are all tradable goods and homogenous across countries, i.e. Armington and Dixit-Stiglitz product differentiation assumptions are not considered. Trade links exist between all regions in the model for all goods. The production structure of the three sectors is a reflection of this paper's focus on the role and impact of the trade in Mode 1 services, and can be seen in Figure 2.

[9] For details of how a mixed complimentary problem is set up in MPSGE, please see Appendix B.

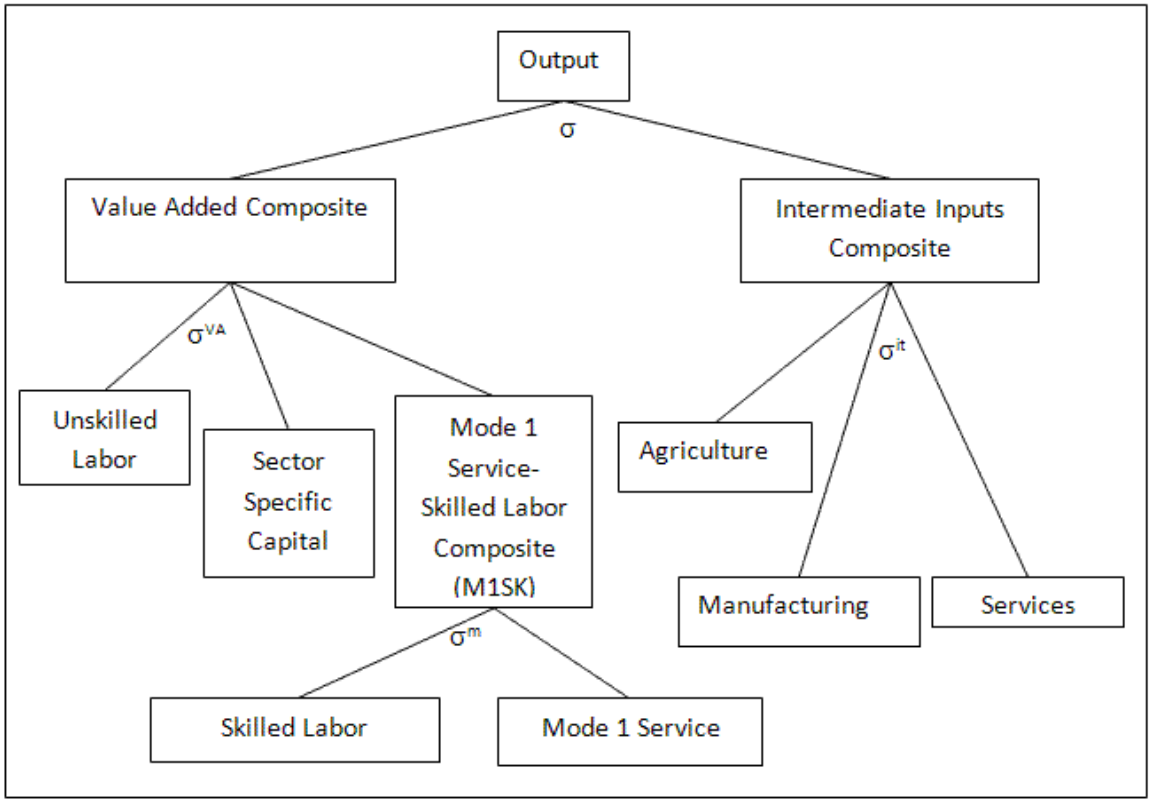


Figure 2 Production Structure in Model

The top most nest of the production structure assumes a Leontief technology relating a composite of value added and Mode 1 services inputs to an aggregate of intermediate inputs, referred to henceforth as just value added. The intermediate inputs are themselves used in fixed proportions to construct the composite intermediate input. The value added input nest relates capital and unskilled labor to a composite of skilled labor and Indian Mode 1 services inputs with an elasticity, σ^{VA}. The bottom-most nest relates skilled labor to these services through an elasticity of substitution (σ^{m}) greater than one to produce the composite hereafter referred to as M1Sk.

The last nest relating skilled labor and Mode 1 services is a reflection of the intuition behind how Mode 1 services are theorized to interact with the skilled labor. Skilled labor, a crude aggregate of several occupational groups, essentially provides a specific service in the production structure of an industry. When that service can be imported, it is not a substitute for the "services" intermediate input in the production structure, but rather competes with the service offered by the skilled worker. For example, a US accountant is substitutable with an accounting service provided electronically from India. Skilled and unskilled labor cannot be

traded directly in this framework, and so all labor is domestic, by definition. The nesting structure also reflects the assumption that skilled labor is a proxy for the set of Mode 1 substitutable occupations, while unskilled labor is a proxy for the set of unsubstitutable occupations.

This labor dichotomy serves as an approximation given the level of aggregation in the database being used. Blinder (2007), Jensen and Kletzer (2006), and Bardhan and Kroll (2003) have provided subjective as well as empirically grounded lists of labor groups in the USA at the SOC 2-digit level that would be substitutable with Mode 1 services. Unfortunately, there are no equivalent studies for India that could provide a basis for greater disaggregation of the higher skilled sections of the Indian labor force. It is reasonable to assume that Mode 1 services are substitutable with just skilled labor, as opposed to unskilled labor or both labor types, since the types of activities that Mode 1 services cover require a high level of skill.

Furthermore, workers are perfectly mobile across sectors, although they cannot move between the skilled and unskilled categories, with the wages of a given labor type equal across industries, although they are not necessarily equal to each other. Since investment in capital – human or otherwise – is not possible in the model, the effects of education on the labor market composition are also are ignored. The numbers of each type of worker are thus fixed. These are tolerable constraints for this analysis, since the length of time that will be analyzed is not long enough to allow for major changes in labor endowment size and composition.

Mode 1 services are traded from one country to another through a one to one "production" relationship with domestically produced "nontradable" services. Improvements in the technology of this transformation production would make it cheaper for nontradable services to be transformed into Mode 1 services. This is akin to a reduction in the technological barriers or transactions costs associated with services trade.

This general equilibrium framework thus allows for analysis of increased outsourcing through increases in the Mode 1 services trade. As services-trade barriers are reduced, the wages received by different labor groups in India will adjust, even as the factor uses within each industry changes. These changes can then be analyzed to address the research question.

4.2 Data

The structure of the MPSGE framework and its compatibility with the SAM data format makes it suitable for use with the GTAP Data Base Version 6 (Dimaranan, 2006)[10]. The input-output structure provides the core of the database to be used with the general equilibrium framework described above. Since, the full GTAP Data Base has more information than is necessary for the analysis in this paper, I adjust for savings-investment and trade protection data to construct a consistent global SAM using cost structure, factor income, and final demand data. This is an accurate, yet frictionless, delineation of the input-output structure of the integrated world economy (Table A-1, Appendix A).

The GTAP services data are based on the 2003 IMF Balance of Payments Statistics[11]. Mode 3 (commercial presence) services have no coverage in the GTAP database, freight data are incorporated into the margin services data, and travelers' expenditure can be considered to be GATS Mode 2 (consumption abroad). That leaves the other non-margin services as an amalgamation of Mode 1 and Mode 4 (temporary movement of natural persons) services. The service trade data from the IMF, and built into the GTAP services trade data, are thus already parsed to separate Mode 1 services from the other service data, making the GTAP Data Base best suited to the task of examining the trade in services.

As mentioned earlier, Armington product differentiation is not assumed, and imported intermediate inputs are considered to be the same as domestically produced intermediates. An exception is the difference between services used as intermediate inputs and Mode 1 services. Mode 1 services are produced when a fraction of the exporting country's services output are transformed into Mode 1 services and exported as intermediate inputs. They then enter the production framework of an importing country's industry as an input in a nest distinct from domestically produced services. Domestically produced services, on the other hand, are used in fixed proportions in the intermediate inputs nest. The composite of these intermediate inputs is in turn used in fixed proportions in the top-level of the CES production relationship. Domestically produced services thus do not substitute for any factor endowment, while Mode 1 services compete (or complement) skilled labor in the valued added nest of the production structure.

[10] Base year 2001

[11] The service sector is an aggregate of the following GTAP sectors: Electricity, Gas Distribution, Water, Construction, Trade, Transportation, Sea Transport, Air Transport, Communication, Financial Services, Insurance, Business Services, Recreation and Other Services, Other Government Services, Dwellings.

The cost shares of Mode 1 services and skilled labor are the highest in the Indian services sector. While the unskilled labor share is larger than the skilled labor cost share, unskilled labor's cost share is greatest in the agriculture sector.

The services sector is also responsible for 46 percent of India's total output, and is thus the largest industry in the Indian economy. 2.6 percent of this output is exported as Mode 1 services, and is worth US$ 10.12 billion in the benchmark database. In contrast, export values of the agriculture and manufacturing sectors are three to seven times greater than Mode 1 exports, despite those industries' shares of total output being less than that of the services sector.

5. Analysis

The analysis is based on a simulation of the historical changes in India's services trade and how they may have affected the factor incomes in India between 2001 and 2006. The initial database used in this analysis has 2001 as a base year. So, by introducing specific technological improvements into the global trade of Mode 1 services, the Indian services trade will then be simulated to reflect the trade patterns of 2006. Specifically, Indian services exports will be increased by 400 percent, while Indian Mode 1 imports will be increased by 280 percent. These are the approximate changes in Mode 1 exports and imports over the period 2001-2006.

These sharp increases in Mode 1 service trades may be made possible through technological improvements that would allow more services to be internationally traded at lower costs. These technological improvements can be conceptualized as being any technological advancement that makes it easier to deliver these services[12]. For example, they may take the form of improvements in satellite based communication or greater internet bandwidth, which would allow electronic data to be transferred from India to other countries at faster speeds, lower costs, and greater reliability.

[12] While this paper uses technological improvement as an abstract agent representing the multitude of forces that would have affected the services trade. As NASSCOM-McKinsey (2005) suggest there are several other forces whose synergy may have contributed to the rising trade, including technological improvement, demand increases from outsourcing countries, and large pool of skilled Indian labor that could be easily mobilized to the services industry. Policy reforms such as the liberalization of an overvalued exchange rate would have also removed constraints to the imports of inputs necessary for export growth.

International capital flows are not possible in this model, so all the changes in the Indian economy are going to be driven by the changes in India's Mode 1 services trade. Since the model holds constant investments in human capital, the analysis can ignore the obfuscating effects of Indian FDI on the labor market. The changes in factor uses and incomes, and by extension the distributional changes, in the period 2001-2006 can thus be identified and examined as being driven purely by the trade changes.

5. 1 Calibration

As a preliminary to the analysis of the simulated trade changes, the model is calibrated to capture one additional piece of information. The widely reported wage increases for professionals in India have been cited as an important indicator of how greater services exports have contributed to Indian development. During 2001-2006, Indian wages were seen to rise rapidly. Given the nature of the shock, the simulated Mode1 services export and import changes would undoubtedly affect the in-model wages of skilled labor. The direction and magnitude of this depends on the elasticities of substitution in the production structure.

The elasticity of substitution between skilled labor and Mode 1 services (σ^m) is thus calibrated such that the simulated historical changes in Mode 1 services trade will yield an increase in the skilled wage equivalent to the historical changes in the salaries of professionals between 2001 and 2006[13]. According to the Hewitt Associates report, the wage increases in 2006 were at least 11.9 percent (Financial Express, 2006). If we take this as a very optimistic lower bound on the annual wage increase for the period in question, then Indian wages should have experienced an increase of 75 percent. However, these would have been increases in nominal, not real, wages. After deflating the annual wage increase by the average annual inflation rate for that period, 4.7 percent (Index Mundi, 2008), the wage increase for the period is determined to be 39 percent.

[13] The analysis is thus conducting a historical simulation of the Indian economy between 2001 and 2006, by changing Mode 1 services trade flows by the historically observed amounts, with the model calibrated to yield the historically observed 39 percent change in the skilled labor wages. All other changes in the Indian economy will thus be results of the simulation. Given that I hold several variables (like FDI) constant, analysis and calibration allow for a pure analysis of trade impacts alone, with the simulated changes in the Indian economy not necessarily matching historically observed changes beyond changes in Mode 1 services and changes in real skilled wages.

It is around this historical wage increase that the elasticities of substitution between Mode 1 services and skilled labor (σ^m) in India and the Rest of the World are calibrated[14]. In countries that are major demanders of Indian Mode 1 services, the Indian services are conceptualized as competing directly with the activities of skilled workers in the Rest of the World due to their lower costs. Mode 1 service imports are thus substitutable with labor in the importing countries. Examples of this would be activities such as data processing or telemarketing, where the imported data is used by a firm for activities that could be done by workers employed within the firm or industry. Consistent with this assumption, an arbitrarily high elasticity of substitution (five) is chosen for the Rest of the World.

The differences in the cost of Mode 1 services and labor prices in the importing country thus provide some intuition into how Mode 1 services from India and labor in the Rest of the World relate to each other. I can apply this intuitive approach to now determine the relationship between labor and Mode 1 services in Indian production. Indian labor costs are lower than labor costs in the countries that import its services (e.g. the USA, UK, Germany, inter alia[15]), and so the Mode 1 services from those countries must cost more than the Indian workers that are involved in the same activities. A relationship of substitutes between Mode 1 services and Indian labor is thus counter-intuitive. Since the relatively lower factor prices in India means that there is no factor price advantage that Indian firms can exploit through outsourcing, it is reasonable to conceptualize the imported services as being complementary to the skilled Indian workers. For example, management consulting services or personnel development services provided from more developed countries can be considered complementary to skilled indigenous personnel. The elasticity of substitution (σ^m) in India must thus be low.

Figure 3 shows how the skilled wage changes for different σ^m values assuming the same increases in Indian exports and imports of Mode 1 services. Note that for values above 0.15, skilled wages fall in India. This contradicts the empirical evidence over this period and so larger values must be ruled out. Taking the elasticity of substitution in the Rest of the World as given, and targeting the historical skilled labor wages rise, The elasticity of substitution between Mode

[14] Due to data constraints, robust estimates of this elasticity through statistical methods are challenging to determine. A calibration approach that is internally consistent is taken here instead.

[15] More than 53 percent of Mode 1 services imported into India are from the USA, UK, Germany, France, Italy, Japan, Singapore, Spain, and the Netherlands, according to data from the GTAP Database V.6 (Dimaranan, 2006).

1 services imports and skilled labor in India that allows the model to replicate the historically observed skilled labor wages rise is then found to be 0.045[16].

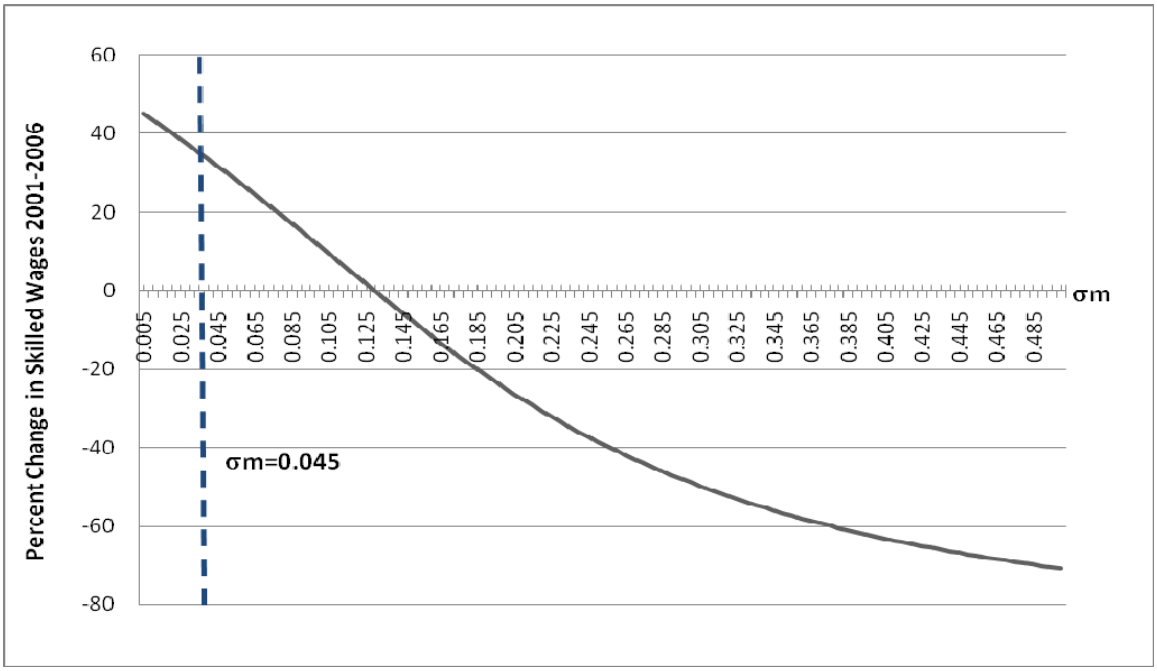


Figure 3 Skilled Wage Percent Change at Different Elasticities of Substitution between Skilled Labor and Mode 1 Services from Historical Services Trade Changes for India (2001-2006)
Source: Author's Simulations

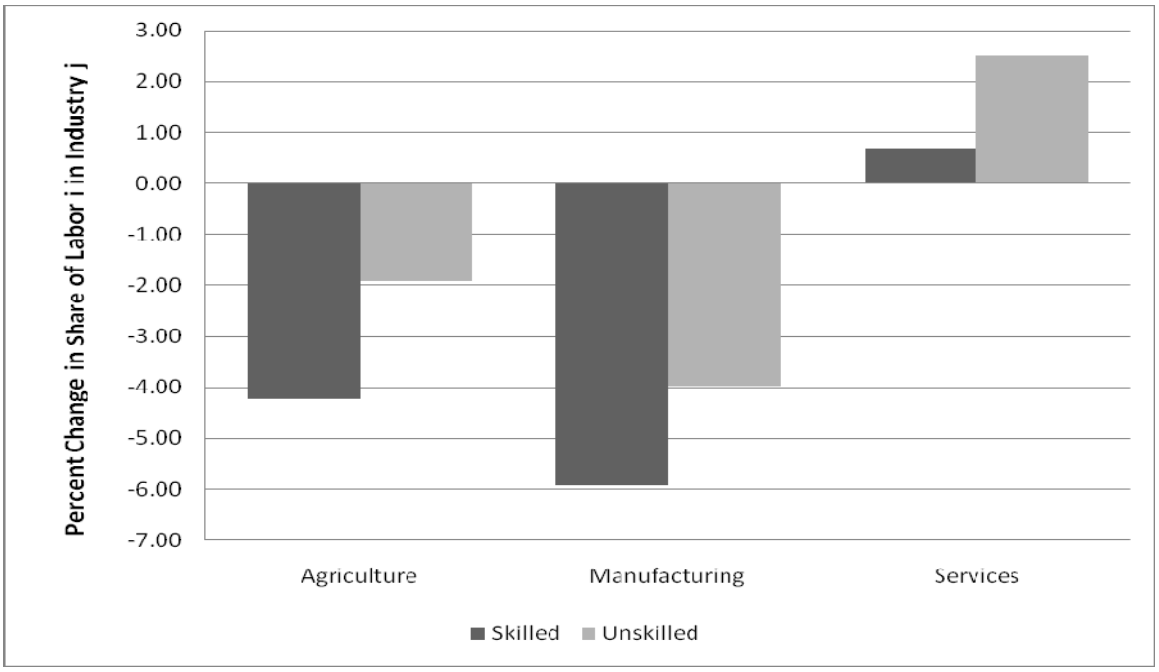
5.2 Factor Use Changes

The simulated historical changes in Indian Mode 1 services exports and imports filter through the rest of the Indian economy through two main gateways. The first is through the increased demand for Indian services resulting from the higher export demand; while the second is through changes in the production structures of the different industries brought on by more and cheaper Mode 1 services imports.

Starting with the export effect, the 400 percent increase in demand for cheaper Mode 1 services exports pulls up the services sector's output by one percent. Given the large increase in the export volume, it may be confusing as to how this small increase in output is able to meet the higher demand. The answer to this mystery lies in the export share of the industry's output, which grows from 2.6 percent to 12.9 percent.

[16] Appendix C analyzes the sensitivity of the results to alternative choices for India's elasticity of substitution between Mode 1 services and skilled labor.

The industry's expansion increases the sector's demand for inputs, namely labor and capital. The services sector meets the demand for unskilled labor by pulling in workers from the agriculture and manufacturing sectors (Figure 4), pushing up their wages by 7 percent[17] (Table 1). To complement the unskilled labor, the quantity of Mode 1 – skilled labor composite input (M1Sk) also increases, by using more skilled labor as well as imported Mode 1 services. With the greater demand in the services sector, skilled labor is drawn away from the manufacturing and agricultural industries, consistent with the higher observed (and simulated) wages in this time period.



Source: Author's Simulations

Figure 4 Percentage Change in Labor Share Employed by Indian Industry j due to Changes in Mode 1 Services Trade (2001-2006)

[17] All prices are relative to the numeraire. In this model the numeraire is the price of a composite global welfare good, which thus acts as a consumer price index.

Table 1 Percent Changes in Prices from Benchmark due to Mode 1 Services Trade in India (2001-2006)

	Percent Change
Factor	
Skilled Labor	39.48
Unskilled Labor	6.83
Capital (Agriculture)	-12.00
Capital (Manufacturing)	-28.81
Capital (Services)	36.87
Output	
Agriculture	0.01
Manufactures	-0.05
Services	18.84

Source: Author's Simulations

Note: Numeraire is composite global consumer price index

During the time period under consideration, technological improvements also decrease the import cost of Mode 1 services into India enough to allow its imports to rise by 280 percent. The increased Mode 1 services imports, complements to skilled labor, contribute to increases in M1Sk composite quantities. With more skilled labor drawn in from other industries, and with the cheaper and more abundant Mode 1 service imports there is thus an increase in the quantities of the M1Sk composite used. Table 2 illustrates this.

Table 2 Percent Change due to Mode 1 Services Trade in Input-Output Quantity Ratios by Input and Industry in India (2001-2006)

	Agriculture	**Manufacturing**	**Services**
	I	**II**	**III**
Skilled Labor	-3.39	-4.13	-0.30
Unskilled Labor	-1.06	-2.14	1.49
Capital	0.88	1.91	-0.99
Mode 1 Services	81.43	81.20	88.45
Composite	0.74	4.47	12.30

Source: Author's Simulations

Capital, unlike the other inputs, is sector specific. So, the increased demand for capital in the service sector does not translate into an increase in the quantity, but rather a large increase in its price (37 percent). The overall effect of the higher prices of labor and capital inputs is to increase the price of services sector output by 19 percent.

In contrast to services, the Indian agriculture and manufacturing sectors experience declines in their output driven by declines in inputs demands. To begin with, both industries lose workers to the services industry (Figure 4). Unskilled workers are complements to the sector specific capital and the Mode 1 – skilled labor composite (M1Sk). The falling demand for unskilled workers pushes down the demand for capital and M1Sk alike in the non-service industries. Since the supply of sector-specific capital is fixed, their declining demands translate into decreases in capital prices. At the same time, there are decreases in the quantity of the M1Sk composite in agriculture, driven by an exodus of skilled workers to the expanding services sector.

It should be noted that the influx of Mode 1 services imports is able to dampen the decline for the M1Sk composite demand in agriculture, and increase the demand in manufacturing. Relative to output, more Mode1 service imports and M1Sk composite inputs are used in agriculture and manufacturing, even as labor is used relatively less. These changes in labor and M1Sk use are apparent when looking at columns I and II of Table 2.

The non-services industries also experience changes in their output prices. The increase in lower priced inputs like capital and Mode 1 services puts downward pressures on agriculture and manufacturing prices. At the same time higher wages put upward pressure on output prices from non-service industries. Ultimately, the prices of Indian agriculture and manufacturing are determined internationally. India is a price taker in the international market for output from these two industries, being responsible for only 1.6 percent of global output, and relatively small shares of global commodities trade. In this historical simulation, the price of agricultural goods increases, while the price of manufacturing goods decreases. However, the magnitude and direction of the price changes in manufacturing and agriculture are sensitive to the substitutability of skilled labor and Mode 1 services in the production structure of the Rest of the World. For the manufacturing sector, the magnitude of the impacts decrease as the substitutability increases, while they first decrease and then increase for agriculture.[18]

[18] Appendix C analyzes the sensitivity of the results to alternative choices for India's elasticity of substitution between Mode 1 services and skilled labor.

5.3 Implications for Development

Let us now return to the research question of what have been the distributional implications of the services sector's growth between 2001 and 2006. This question can be answered by revisiting the factor price changes. The total factor income in India is found to increase by 12 percent over this period, indicating that the Mode 1 services trade has been beneficial to India, considered as a whole. However, a closer examination of the income changes for individual factors tells a more complex story.

Table 3 illustrates the changes in total income by factor and sector and highlights the growth of the income gap between agriculture and services capital owners, and skilled and unskilled workers. As can be seen, the total factor income in agriculture and manufacturing decreased, with the declines being driven by the income losses suffered by the sector specific capital owners. These income losses were about US$ 5 billion and US$ 12 billion in the agriculture and manufacturing sectors respectively, representing declines of 12 to 29 percent in income from capital. In contrast, the income from services sector capital increased by US$ 70.25 billion – a rise of more than a 36 percent from the 2001 income.

Growing inequality can also be seen in the labor force, even though the incomes of skilled and unskilled workers are increasing. Unskilled workers represent 76 percent of the Indian labor force. Unskilled workers' wages increase by 7 percent as a result of the Mode 1 service changes. However, the improvement in their wages is much smaller than the 39 percent wage increase enjoyed by skilled workers, who represent a much smaller share of total labor[19]. This is reflected in the changes in total income of these two groups. The income of the skilled labor group rises by US$ 18.9 billion, while the income of the unskilled labor group rises by US$ 10.3 billion.

[19] Recall that the numeraire is the price of an aggregate global welfare good, which normalizes all prices and price changes.

Table 3 Change in Total Income by Factor and Industry due to Mode1 Service Trade between 2001 and 2006 (2001 US$ Millions)

		Skilled Labor	Unskilled Labor	Capital	Total Industry Income
Agriculture	**Base**	1,533.72	45,333.52	67,104.73	113,971.97
	Change	515.07	2,164.30	-8,054.77	-5,375.39
Manufacturing	**Base**	3,893.31	27,424.08	48,736.36	80,053.75
	Change	1,215.15	706.53	-14,042.86	-12,121.17
Services	**Base**	42,555.43	78,157.48	123,703.90	244,416.81
	Change	17,215.43	7,429.94	45,613.40	70,258.78
Total Factor Income	**Base**	47,982.46	150,915.08	239,544.99	438,442.53
	Change	18,945.66	10,300.78	23,515.78	52,762.21

Source: Author's Simulations

5.4 Decomposition by Direction of Trade

In light of the changes in factor prices and total factor incomes by sector, the contribution of the Mode 1 exports must be separated from the contribution of imports, as proxies for the export demand effect and the Mode1 import supply effect. This decomposition is important for a deeper understanding of the mechanisms at work and the possible implications of restricting imports or exports of Mode 1 services.

Table 4 show the individual contributions of Mode 1 exports and imports to Indian factor price changes (columns I and II), and to the change in the total incomes of each factor (columns III and IV). The directions of the impacts (positive or negative) attributable to each trade flow direction are the same. However, the magnitudes of the export demand effect and import supply effect are quite different. The import effects of Mode 1 services were much smaller than the effects of Mode 1 services exports. This is consistent with the popular perception that Indian Mode 1 services exports are improving incomes, although the Mode 1 import supply effect is important for skilled labor wages.

The most significant differences are in the prices of capital in agriculture and manufacturing, which decline much more due to exports than due to imports. This can be explained in part by the pressures of the real appreciation caused by higher export demand for services. As more services are exported, exports of agriculture and manufacturing decline while imports of these commodities rise.

Table 4 Decomposition of Trade Effects

	Percent Changes in Factor Prices		Change in Total Income by Factor (US$ Millions)	
	I	II	III	IV
	Import Supply Effect	Export Demand Effect	Import Supply Effect	Export Demand Effect
Skilled Labor	10.14	29.33	4,866.73	14,072.39
Unskilled Labor	0.58	6.37	876.90	9,614.60
Capital (Agriculture)	-0.54	-11.60	-360.60	-7,780.91
Capital (Manufacturing)	0.00	-29.00	-1.03	-14,134.24
Capital (Services)	1.44	35.55	1,783.20	43,972.40

Source: Author's Simulations

Another contributing reason for the differences in effects can be traced back to how they affected inputs demands in the services sector. Mode 1 service imports into India are complements to skilled labor. So, when Mode 1 imports into India increase, they also increase the demand for skilled labor, especially in the services sector where they are used the most intensively. So, there is a small increase in the demand for skilled workers, pushing up their wages, and that of the other inputs – unskilled labor and sector specific capital. With labor being pulled away from non-service industries, the demand for specific capital in those industries declines, although the rental rate of capital declines by only a small amount in agriculture.

The increase in the demand for labor caused by the increase in Mode 1 services supply, however, is much smaller than the increase in the demand for labor caused by the increased export demand. The greater demand for Indian Mode 1 services (the export demand effect) pulls up the demand for labor and capital much more than the increase in Mode 1 import supply (the import supply effect), leading to larger quantities of skilled and unskilled labor leaving the non-services industries. With larger numbers of labor leaving those industries, demand for and income from sector-specific capital decline, leaving owners of those types of capital worse off.

This decomposition thus shows that the imports of Mode 1 services were not responsible for most of the decline in the income of capital owners in agriculture and manufacturing. In contrast, the higher demand for labor caused by the services sector trying to meet the higher Mode 1 services export demand is responsible for the income declines.

5.5 Limitations and Further Work

The analytical framework of this analysis has a few limitations that are necessary to put the results in the appropriate context. Since the wages of skilled labor were used to calibrate the model, the insights gleaned on how the prices of non-skilled labor factors change must be considered relative to the observed skilled wage increase. Also, the skilled wage increase in the analysis is driven purely by the services trade shock, and does not consider other possible contributors to wage determination that would have undoubtedly played a role in reality. While the results of the analysis can be considered an upper bound on the possible impacts, this upper bound could be reduced in future work by considering the other factors influencing the wage increase.

The stylized model considered in this analysis is limited to a short to medium run timeframe, where there are no changes to capital stocks, savings, and investments. While the numerical results presented here are still valid when considering short-run timeframes when capital cannot adjust, they would not be good predictions of a longer timeframe where capital stocks in each industry can change. As Kohler (2001) has pointed out, foreign direct investment is an especially important variable when determining the factor price changes and welfare effects for a service exporter. This is especially true when examining a country like India that has seen such large increases in FDI in the recent past.

Also, the empirical framework of the model rests on the strong assumptions made about the relationship between skilled labor and Mode 1 services in production. For the Rest of the World the elasticity of substitution between them was assumed to be a value that was arbitrarily high, such that it captured the idea that Mode 1 services could substitute for skilled labor in production. The corresponding elasticity in India was then calibrated to be able to replicate historically observed wage changes. While the implications of the assumed values of these elasticities seem reasonable since the focus of the paper was India, empirical estimates would undoubtedly enhance the accuracy of the analyses.

6. Conclusion

Mode 1 services exporting sectors are an increasingly important part of the Indian economy. With Mode 1 service exports and imports both having grown by several hundred percent between 2001 and 2006, the services sector's expansion has been viewed as a key driver of Indian growth. However, the benefits of the services sector's growth to the rest of the

Indian economy are ambiguous, weakening the extent of its claimed contributions to development.

There are several reasons why the contributions of Mode 1 services trade to Indian development are not well understood. The period 2001-2006 was one of rapid increases in FDI for India, obfuscating the impact of the significant services exports and imports growth in that period. Theoretical models that have attempted to predict and explain the effects of increased outsourcing have also failed to provide solutions that hold up when subject to generalization. Analytical solutions from models that accurately depict the real world are difficult to obtain since the problem would require too many dimensions to be able to solve with any ease.

This paper provides insight into this problem by using a simulation model built on a specific-factors framework and using real world data to obtain an upper-bound numerical solution of how sensitive factor prices in different sectors may have been to the increase to the Indian services exports and imports observed between 2001 and 2006. To focus on the contributions of just the changes in the services trade, the model ignored FDI flows and was calibrated such that the services trade changes led to the historically observed changes in skilled wages.

As a result of this partial, historical shock, the wages of all workers increased, although unskilled workers' wages rose by only 6 percent, compared to the historical 39 percent increase for skilled workers. Owners of capital in the services sector benefited from the Mode1 trade enhancing technological improvement as the rental rates of capital in that sector rose. At the same time, owners of capital in other industries became worse off as capital prices fell. Driven by the wage increases and the higher rental rates for service sector capital, the total factor income in India increased. However, the sharp losses in factor income for capital specific to the agriculture and manufacturing industries imply a worsening of the income gap between the owners of such capital.

While most of these factor price changes were attributable to expanding demand for Indian Mode 1 exports, increasing supplies of Mode 1 imports also had significant influence on prices. Specifically, they proved improved skilled labor wages and services-sector capital rates to the benefit of skilled workers and capital owners in the services sector. The impact of the increase in Mode1 imports supply on capital rates in non-services industry was extremely small compared to the impact of expanding Mode 1 exports.

The growth of the Indian services trade sector thus has the potential to widen income inequality between different factors, even though total income in India may improve. With Indian services exports expected to continue increasing, development policies that address potential impacts on factors involved in the agricultural and manufacturing sectors may be beneficial. The distribution of income gains is thus an issue that developing countries like India cannot ignore as they evaluate the development contributions of greater Mode 1 trade.

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Appendix A: Data

Table A-1: Simplified Input-Output Table for Global Economy in Millions US$ (Base Year 2001)

		Rest of the World			India				
		Agriculture	Manufacturing	Services	Agriculture	Manufacturing	Services	Final Demand	Total
Rest of the World	Agriculture	1428149	173366	493254	337	718	54	2005626	4101505
	Manufacturing	469179	6748933	3690260	1376	29827	7004	3517591	14464169
	Services	644583	2845321	8361434	77	437	7040	20745855	32604746
India	Agriculture	3929	559	1190	40238	8156	8759	125886	188718
	Manufacturing	1072	23788	8160	8759	91077	51549	85210	269617
	Services	360	2000	7759	23958	59349	71160	225398	389984
	Sector Specific Capital	858736	2130189	8535927	67105	48736	123704		
	Skilled Labor	79398	777544	4920772	1534	3893	42555		
	Unskilled Labor	616099	1762468	6585990	45334	27424	78157		
	Total	4101505	14464169	32604746	188718	269617	389984		

Source: Dimaranan (2006) after extraction and reconciliation by author

Appendix B: Mixed Complementarity Problems in MPSGE

The computable Arrow-Debreu type general equilibrium model used in this paper is built using the MPSGE framework of Rutherford (1999). The formulation relies on three groups of variables: a non-negative vector of prices, a non-negative vector of activity levels associated with constant returns to scale production sectors, a vector of income levels for each income-earning agent – households and governments – in the model.

In this framework, an economic equilibrium must satisfy a non-linear system of equations and inequalities, where there are three types of equilibrium conditions, corresponding to the three groups of variables. The price variables and producer activity levels are associated with market clearing conditions, zero profit conditions, and income-budget equilibrium respectively. This complementarity of the first sets of equilibrium conditions with variables implies that if the equilibrium condition is non-binding then the associated variable is zero, and can be interpreted intuitively. For example, a commodity's price falls to zero if the equilibrium supply of a commodity is greater than the equilibrium. Similarly, if the marginal cost of production in a given activity is greater than marginal revenue, then the activity level drops to zero. The income balance equations do not have complementarity conditions, since the formulation uses them primarily for normalization of the price system and accounting simplification.

A simple GE model can illustrate how the MCP formulation may be obtained. Consider output y_i of industry i, produced with a vector of j factors x_j, and with output price p_i. Let us assume a single household that consumes a welfare good W, comprising a vector of y_i, and with a "price" w. Such an economy can be characterized by equations B-1 to B-3.

$$y_i = f_i(\tilde{x}_j) \qquad \text{Eq. B-1}$$

$$W = g(\tilde{y}_i) \qquad \text{Eq. B-2}$$

$$I = \sum_j r_j * x_j \qquad \text{Eq. B-3}$$

Equation B-1 describes the production of output of industry i. Equation B-2 describes household consumption, while equation B-3 describes the household income, where r_j is the return factor j. Furthermore, the total of factor j used in the economy is equal to a fixed amount (i.e. fixed endowment) equal to $\overline{x}_j$.

The MCP formulation that is used in MPSGE solves the underlying cost minimization problems for consumers and producers first, so that individual optimizing behavior is embedded in the model. For that, we need to consider the unit cost function of output i, cy_i, which is a function of factor prices (equation B-4). We also need to consider the unit expenditure function of the consumer (e), which is expressed in terms of a vector of output prices ($\tilde{p}_i$), as seen in equation B-5.

$$cy_i = Cy_i(\tilde{r}_j) \qquad \text{Eq. B-4}$$

$$e = E(\tilde{p}_i) \qquad \text{Eq. B-5}$$

From Shephard's lemma, we know that taking partial derivatives of unit cost and expenditure functions with respect to the factor prices and commodity prices, respectively, will yield optimal factor and commodity demands. The general equilibrium model can now be specified as a square system of n weak inequalities in n unknowns. The zero profit conditions (more precisely non-positive profit conditions) and their complementary variables are seen in Equations B-6 and B-7. They are followed by the market clearing conditions, which show the commodity, factor, and the aggregate welfare good demands and their complementary variables in equations B-8, B-9, and B-10. Equation B-11 is a repeat of equation 3, the income balance equation, and as such, has no complementary variable.

$$cy_i \geq p_i \perp y_i \geq 0 \qquad \text{Eq. B-6}$$

$$e \geq w \perp W \geq 0 \qquad \text{Eq. B-7}$$

$$y_i \geq \left(\frac{\partial e}{\partial p_i} * W \right) \perp p_i \geq 0 \qquad \text{Eq. B-8}$$

$$\overline{x}_j \geq \sum_j \left(\frac{\partial y_i}{\partial r_j} * y_i \right) \perp r_j \geq 0 \qquad \text{Eq. B-9}$$

$$W \geq \frac{I}{w} \perp w \geq 0 \qquad \text{Eq. B-10}$$

$$I = \sum_j r_j * x_j \qquad \text{Eq. B-11}$$

The GE model has thus been specified as a mixed complementary problem which can be solved for an equilibrium. The MPSGE framework allows for the specification of much more complex GE models, but using utility and production functions in the CES (or constant elasticity of transformation, if appropriate) functional form.

Appendix C: Sensitivity Analysis and International Commodity Prices

The historical simulation of this analysis has been designed to recreate the changes in the volume of Mode 1 servcies exported and imported into India in the period 2001-2006. The elasticity of substiution between Mode 1 services imports and skilled labor in Indian production (σ^m, from Figure 3) is calibrated to recreate the 39 percent increase in skilled wages observed in the considered period.

One of the impacts of the increased Mode 1 services exports has been to change the input demands and sector outputs of industries in the Rest of the World (ROW). The magnitude of these changes depends on the substitutability between Mode 1 services imported from India and domestic ROW skilled labor (σ^m in ROW). For the main simulations of this paper, the elasticity of substitution was arbitrarily chosen to be equal to 5, to model Mode 1 services and skilled labor as substitutes. In major developed country service exporters, such as the USA, the Mode 1 services that are imported are considered to be direct competitors for skilled labor engaged in the same activity that is being imported. As such, any elasticity that is greater than one is sufficient for this assumption to be modeled. Figure C-1 illustrates how the international prices of commodities vary under different elasticities given the same Mode1 services exports and imports shocks to India. The value of σ^m in the Rest of the World does not impact the results for the Indian economy since the factor prices and demands are driven by the exogenously determined changes in the Mode 1 services trade.

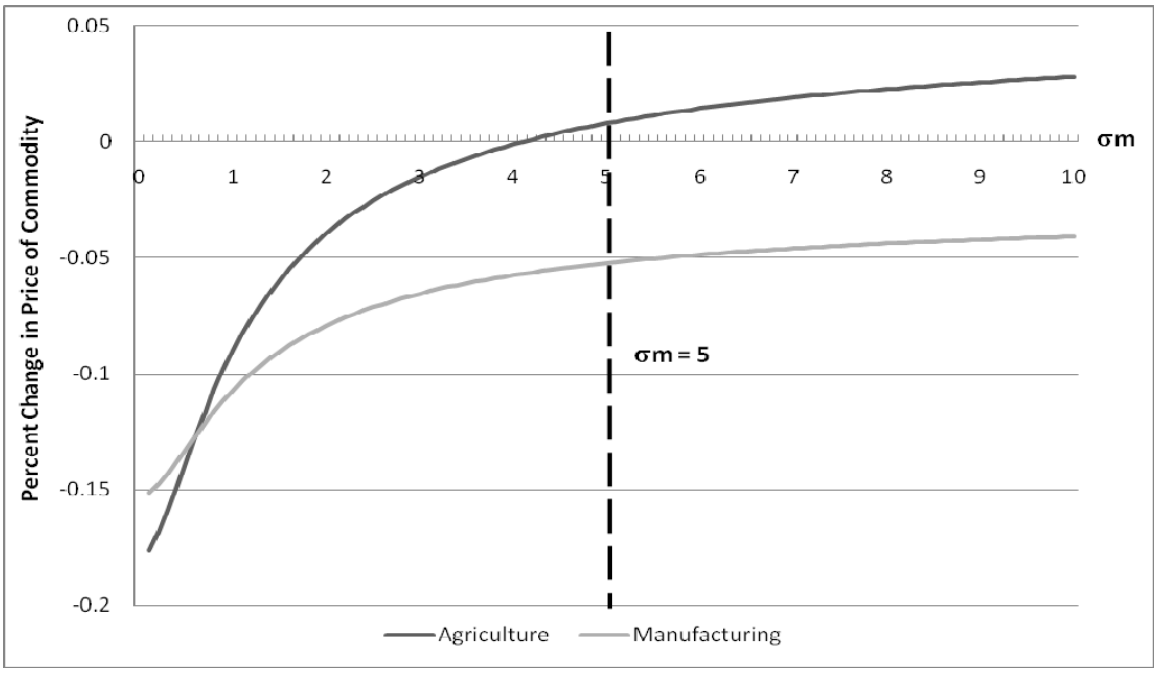


Figure C-1 Percent Change in Internationally Determined Price of Commodities for Historical Changes in Indian Mode 1 Services Trade as σ^m for Rest of the World Varies (2001-2006)

Source: Author's Simulations