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Jobs Attributable to Foreign Direct Investment in the United States

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Executive Summary

- In 2013, majority-owned U.S. affiliates of foreign firms employed 6.1 million people.
- In addition to these direct jobs, foreign direct investment (FDI) contributes to a number of indirect jobs. These include, for example, jobs in sectors that supply goods and services to foreign firms. Little is known about the true number of jobs attributable to FDI in the U.S. due to the difficulty in computing the number of indirect jobs.
- To overcome this difficulty we use the United States Applied General Equilibrium (USAGE) model to estimate the total jobs attributable to FDI. We examine two channels through which FDI stimulates employment.
- First, we estimate the jobs attributable to the existing foreign-owned capital stock. These include jobs in foreign firms' supply and distribution chains, jobs stimulated by increased incomes, and other economic effects.
- We find that in addition to 6.1 million direct jobs, the existing stock of FDI contributes 2.4 million indirect and induced jobs, for a total of 8.5 million jobs.
- Second, we estimate the jobs attributable to productivity growth associated with FDI. These include the jobs stimulated by the economic benefits of technology spillovers from foreign firms.
- We find that in the manufacturing sector alone, productivity growth from technology spillovers associated with FDI contributed 3.5 million jobs.
- In total, 12 million people (8.5 percent of the labor force) have jobs in the U.S. due to either direct employment at foreign firms (6.1 million), indirect and induced employment from foreign firms (2.4 million), or indirect and induced employment from productivity spillovers (3.5 million).

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1. Introduction

In 2013, majority-owned U.S. affiliates of foreign firms employed 6.1 million people, or 5.17% of domestic private-sector employment.[1] This figure is often cited as the jobs supported by inward foreign direct investment (FDI).[2] These direct jobs, however, tell only part of the story. U.S. affiliates of foreign firms also contribute to jobs in their supply and distribution chains (indirect jobs), and contribute jobs due to increases in demand associated with higher income and other effects (induced jobs). In this paper we estimate the total number of jobs attributable to FDI in the United States, inclusive of these second order effects.

Input-output models are often used to quantify indirect and induced employment effects. For example, Harper and Cotton (2013) use an input-output model to estimate the total jobs supported by FDI in the Nashville region. They find that in addition to 30,000 direct jobs, foreign firms in Nashville support 53,000 indirect and induced jobs.

The Organization for International Investment (2015) uses an input-output model to estimate the total jobs supported by increased FDI from the Transatlantic Trade and Investment Partnership (TTIP) and Trans-Pacific Partnership (TTP) agreements. They find that in addition to 400,000 direct jobs, FDI facilitated by TTIP and TTP would support an additional 1,030,000 indirect and induced jobs.

Input-output models, however, rely on a number of restrictive assumptions that can lead to overstated economic impacts. Bess and Ambargis (2011), for example, note that I-O models do not account for price changes that may result from increased competition for scarce resources, known as general equilibrium effects. Rose (1995) also notes that I-O models do not consider resource supply implications, and emphasizes that I-O models overestimate the effects of a shock to the economy, particularly with respect to income and employment effects. Peacock and Simpson (2004) point out that an input-output analysis of the Scottish economy leads to employment estimates that exceed the entire workforce of Scotland.

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[1] U.S. Bureau of Economic Analysis, "Foreign Direct Investment in the U.S.,Majority-Owned Bank and Nonbank U.S. Affiliates (data for 2007 and forward),Employment," (accessed January 10, 2016). According to "A Guide to BEA's Direct Investment Surveys," a U.S. affiliate is majority owned if the combined direct or indirect voting ownership interest of all the foreign parents of the U.S. affiliate exceeds 50 percent. Foreign Direct Investment does not include portfolio investment.

[2] See, for example, Fernandez (2011); and Payne and Yu (2011).

Thus direct employment data omit indirect and induced employment effects, and input-output analyses likely overstate these effects. Our approach is to find a middle ground between these two measures. We use the United States Applied General Equilibrium (USAGE) model, a computable general equilibrium (CGE) model of the U.S. economy, to estimate total jobs attributable to FDI.[3] USAGE core data are based on the BEA annual input-output tables. As such, like input-output models, USAGE accounts for upstream employment effects. Unlike input-output models, however, USAGE incorporates supply-side constraints using price mechanisms and market clearing assumptions. These lead to indirect and induced employment estimates that are more conservative than those of input-output models.

We use two USAGE simulations to estimate the jobs attributable to FDI. In the first simulation we measure the jobs attributable to the existing foreign-owned capital stock. This simulation is presented in detail in section 2. In the second simulation we measure the job gains from productivity growth due to technology spillovers associated with FDI. This simulation is presented in detail in section 3. Finally, we simulate both scenarios simultaneously to estimate the total jobs attributable to FDI. We summarize our findings in section 4.

2. Jobs Attributable to the Existing Foreign-Owned Capital Stock

2.1 USAGE Capital Stock Simulation Methodology

In this section we use the USAGE model to estimate the jobs attributable to the existing inward stock of FDI. USAGE is a complex model that takes into account interrelated changes in labor demand and supply, wages, capital investment, public expenditures and revenues, and exchange rates and trade. For complete technical documentation see Dixon and Rimmer (2002). We highlight some of the relevant features of the model and underlying assumptions below.

We use an approximately 75-sector version of USAGE that corresponds to the BEA annual input-output tables.[4] Capital stock values for each sector in USAGE are estimated using the input-output tables and BEA fixed asset accounts.[5] The base year for these data is 2010.

[3] The USAGE model is a dynamic economy-wide model of the United States. It has been used in applications for the U.S. International Trade Commission, and the U.S. Departments of Agriculture, Commerce, and Homeland Security.
[4] U.S. Bureau of Economic Analysis, "Input-Output Accounts Data," (accessed January 10, 2016).

Our modeling approach is to remove all FDI from the U.S. economy and observe the jobs lost due to this reduction in capital stock. We first create a baseline simulation that models the business as usual economy in 2013, the latest year for which we have industry-level FDI data. We then reduce the capital stock in each industry by the amount attributable to FDI. Relative to the baseline the economy has less productive capacity, leading to declines in output and employment. We interpret the aggregate change in employment as jobs attributable to FDI.

One advantage of this method is that it avoids double counting of direct and indirect jobs. For example, a foreign owned car manufacturer might contribute to indirect jobs in its supply chain by purchasing car components. To the extent, however, that its tire supplier is also foreign-owned, the indirect jobs supported by one foreign firm are also directly employed by another foreign firm. An input-output analysis that applies a job multiplier to each sector would count these jobs twice. In USAGE, however, we can avoid any double counting of direct and indirect jobs.

We simulate this reduction of capital stock under the assumption that there would be no effect on real wage rates. Assuming frictionless labor markets, this allows us to measure how many jobs at current wage rates depend on FDI. If all foreign firms were to leave the U.S. the economy would eventually adjust through falling wage rates, allowing employment to return to normal levels. So in a sense, long-run employment does not depend on FDI. Employment at current real wage rates, however, does depend on FDI. Fixing the real wage allows us to measure the jobs attributable to FDI rather than the welfare gains from FDI due to higher real wages.

We also assume that, absent FDI, there would be no compensating capital investment by U.S. firms. If all foreign firms were to leave the U.S. the economy would eventually adjust through increased domestic investment. If investment by U.S. firms completely compensated for lost foreign investment, long-run employment would not depend on FDI. Fixing the capital stock allows us to measure the jobs attributable to FDI rather than the transitional impacts of domestic investment replacing FDI.

Thirdly, we assume that government spending, as a share of GDP, remains unchanged. In the absence of FDI the economy would be smaller. Less tax revenue from economic activity

[5] U.S. Bureau of Economic Analysis, "Fixed Assets Tables," (accessed January 10, 2016).

means that government spending would have to be curtailed. By keeping government spending constant as a share of GDP, rather than in dollar terms, we measure the jobs attributable to FDI through not only private sector economic activity, but increased tax revenue as well.

A fourth assumption involves the terms of trade. A smaller U.S. economy relative to the rest of the world means higher prices for U.S. exports. Absent FDI the U.S. would export less, but would receive higher compensation via increases in the prices of its exports on world markets. This terms of trade improvement would somewhat mitigate the negative employment impact due to the loss of economic output. Thus we measure the jobs attributable to FDI inclusive of foreign firms' effect on the terms of trade.

We summarize our methodology as follows: We run a counterfactual experiment, reducing the capital stock of the U.S. by the amount that is foreign-owned. As a result, the economy shrinks. With wages and capital held fixed, employment must fall. We interpret the change in employment as the total jobs attributable to FDI (direct, indirect, and induced), inclusive of effects such as reduced government spending and improved terms of trade.[6]

2.2 FDI in the United States: How much is there in each sector?

Having established our methodology, our next task is to determine the share of each sector's capital stock that is foreign-owned. We rely on employment at foreign-owned firms as a share of total employment.[7] This approach is similar to that of Keller and Yeaple (2009), who use employment shares as a measure of FDI in their analysis of international technology spillovers, and Saha, Fikri and Marchio (2014), who rely on employment data for their study of

[6] For more detail on our methodology see Appendix A: Reducing Capital Stock in the USAGE Model -- An Example

[7] We considered using two other BEA datasets to estimate sector-level FDI shares: The first, inward direct investment position, is a snapshot of financing in the form of equity or debt that foreign owners provide to their U.S. affiliates. Unfortunately, there is no comparable economy-wide statistic that would allow us estimate shares of foreign ownership using inward direct investment position. The second, property, plant and equipment (PP&E), consists of land, buildings, structures, machinery, and equipment owned by foreign affiliates. PP&E is comparable to private fixed assets, for which economy-wide data are available. Unfortunately, PP&E is classified by industry of affiliate while private fixed assets are classified by industry of sales. The discrepancies between these two classification systems lead to unrealistic allocations of FDI across sectors when used to estimate FDI shares. As such, we estimate FDI shares using employment data, which are classified by industry of sales and have a convenient economy-wide analog.

FDI in U.S. metro areas. BEA also uses employment data to estimate FDI shares of the U.S. economy by industry.[8]

Employees in foreign firms as a share of employees in all firms are reported in Table 1, below. According to these data FDI is most heavily concentrated in the manufacturing sectors, particularly motor vehicles and chemical products. On aggregate FDI accounts for 5.17% of private sector employment. In the next subsection we report the results of a simulation that reduces the capital stock in each industry by the shares in Table 1.

Table 1: 2013 FDI Employment Shares

NAICS	Industry	FDI Employees (1000s) [9]	Total Employees (1000s) [10]	FDI Share
3361MV	Motor vehicles, bodies and trailers, and parts	369	828	44.6%
325	Chemical products	286	795	36.0%
485	Transit and ground passenger transportation	149	458	32.4%
324	Petroleum and coal products	35	111	31.6%
327	Nonmetallic mineral products	106	373	28.5%
335	Electrical equipment, appliances, and components	91	374	24.3%
331	Primary metals	89	400	22.2%
213	Support activities for mining	84	402	21.0%
326	Plastics and rubber products	115	658	17.5%
311FT	Food and beverage and tobacco products	281	1,671	16.8%
333	Machinery	183	1,107	16.5%
514	Information and data processing services	59	356	16.5%
339	Miscellaneous manufacturing	91	582	15.7%
334	Computer and electronic products	154	1,063	14.5%
3364OT	Other transportation equipment	93	688	13.5%
212	Mining, except oil and gas	27	210	13.0%
523	Securities, commodity contracts, and investments	95	788	12.0%
483	Water transportation	7	67	10.5%
511	Publishing industries (includes software)	87	842	10.4%
486	Pipeline transportation	4	44	9.1%
512	Motion picture and sound recording industries	34	388	8.6%
42	Wholesale trade	468	5,773	8.1%

[8] See Anderson (2012), page 220.
[9] U.S. Bureau of Economic Analysis, "Foreign Direct Investment in the U.S.,Majority-Owned Bank and Nonbank U.S. Affiliates (data for 2007 and forward),Employment," (accessed January 10, 2016), and authors' calculations. These data include 478,000 auxiliary and unspecified jobs that are not associated with any industry. In order to preserve the economy-wide aggregate of 6.1 million jobs, we allocated the 478,000 auxiliary and unspecified jobs proportionally across industries.
[10] U.S. Bureau of Economic Analysis, "Table 6.4D Full-Time and Part-Time Employees by Industry," (accessed January 10, 2016).

322	Paper products	30	377	7.9%
513	Broadcasting and telecommunications	88	1,135	7.8%
482	Rail transportation	15	200	7.7%
487OS	Other transportation and support activities	86	1,166	7.3%
22	Utilities	40	549	7.3%
521CI	Federal Reserve banks, credit intermediation, and related activities	185	2,636	7.0%
211	Oil and gas extraction	12	196	6.4%
561	Administrative and support services	487	7,974	6.1%
332	Fabricated metal products	86	1,426	6.0%
5412OP	Miscellaneous professional, scientific, and technical services	301	5,348	5.6%
5415	Computer systems design and related services	92	1,711	5.4%
524	Insurance carriers and related activities	125	2,391	5.2%
532RL	Rental and leasing services and lessors of intangible assets	28	545	5.1%
313TT	Textile mills and textile product mills	11	232	4.9%
321	Wood products	17	355	4.7%
525	Funds, trusts, and other financial vehicles	4	83	4.3%
44RT	Retail trade	600	15,223	3.9%
722	Food services and drinking places	408	10,390	3.9%
493	Warehousing and storage	25	710	3.5%
323	Printing and related support activities	14	454	3.0%
562	Waste management and remediation services	11	377	3.0%
721	Accommodation	49	1,856	2.6%
315AL	Apparel and leather and allied products	4	174	2.5%
337	Furniture and related products	8	360	2.3%
531	Real estate	31	1,505	2.1%
81	Other services, except government	125	6,851	1.8%
23	Construction	85	6,019	1.4%
621	Ambulatory health care services	70	6,499	1.1%
111CA	Farms	8	789	1.0%
622HO	Hospitals and nursing and residential care facilities	81	8,042	1.0%
713	Amusements, gambling, and recreation industries	11	1,488	0.7%
55	Management of companies and enterprises	15	2,087	0.7%
484	Truck transportation	10	1,397	0.7%
711AS	Performing arts, spectator sports, museums, and related activities	4	582	0.7%
61	Educational services	20	3,389	0.6%
481	Air transportation	2	451	0.5%
113FF	Forestry, fishing, and related activities	3	569	0.5%
624	Social assistance	3	3,297	0.1%
5411	Legal services	1	1,146	0.1%
Private Economy-wide Aggregate		**6,102**	**117,957**	**5.17%**

2.3 USAGE Capital Stock Simulation Results

In this subsection we report the results of a simulation in which we remove all FDI from the U.S. economy in 2013. The macroeconomic effects of this reduction in capital stock are reported in Table 2.

Table 2: Economic Effects of a Reduction in Foreign-Owned Capital Stock

Row	Economic Effect	Change
1	Capital stock	-3.3%
2	GDP	-5.7%
3	Employment (%)	-6.0%
4	Employment (1000s of jobs)	-8,500

As can be seen from Row 1 of Table 2, we have reduced the capital stock by about 3.3%. In other words, based on the sector-level FDI shares in Table 1, FDI accounts for 3.3% of the aggregate economy's capital stock. Readers might wonder why this is lower than the 5.17% private economy-wide aggregate reported in Table 1. First, the 5.17% reported in Table 1 is a share of the private economy (exclusive of government) while the figures in Table 2 are shares of the total economy (inclusive of government). The 3.3% share of total capital stock is equivalent to 4.3% of private capital stock.

Second, sectors differ in their labor intensity. This means that identical sector-level shares will lead to different aggregate labor and capital shares. For example, the motor vehicles industry employs 0.6% of the economy's labor but uses only 0.3% of the economy's capital, so 44.6% of its labor will contribute more to the aggregate than 44.6% of its capital. The lower aggregate capital stock figure suggests that FDI is concentrated in labor intensive industries (FDI accounts for 5.17% of private sector labor, and 4.3% of private sector capital).

In Row 2 of Table 2 we see that the reduction in capital stock attributable to FDI causes GDP to shrink by 5.7%.[11] In other words, though FDI accounts for only 3.3% of the economy's

[11] For context, Ismaylov and Limes (2015) find that FDI contributed $835.6 billion (5.0% of GDP) to the U.S. economy in 2013, as measured by value added of majority-owned U.S. affiliates. This estimate is somewhat smaller than our estimate of 5.7% of GDP. However, value added measures only the difference between each sector's gross output and the cost of its intermediate inputs, or, equivalently, the sum of the costs incurred (except for intermediate inputs) and the profits earned in production, while our methodology includes FDI's impact on upstream and

capital stock, it supports 5.7% of its economic activity. There are two reasons that the impact of FDI on GDP is bigger than its share of capital stock. First, FDI is concentrated in some sectors more heavily than others. Second, absent FDI, government spending would be lower. Each of these effects is discussed in detail below.

The main reason for the relatively large impact of FDI on GDP is the uneven allocation of FDI across sectors, the effects of which can be seen in prices. Absent the goods and services being produced by foreign owned firms, domestic supplies of these goods and services would be more expensive. Although the magnitude of the change in price depends on demand-side (as well as supply-side) factors, it tends to be larger in sectors with the biggest reduction in supply. For example, prices of motor vehicles (15%), petroleum and coal products (16%), and chemicals (13%) all rise significantly as a result of the reduction in capital stock in those industries. To put it another way, the heavy FDI presence in these sectors increases supply of these goods and keeps prices down, which benefits consumers of these goods throughout the economy.

To demonstrate this effect, consider a simulation in which we apply the same aggregate capital reduction allocated evenly across private industries. In other words, instead of reducing capital stock by the shares in Table 1, we reduce capital stock by 4.3% in each sector. This leads to the same 3.3% aggregate reduction in capital stock. Without the heavy concentration of capital in any given sector, however, the supply shock is spread more evenly throughout the economy. The price of motor vehicles (-0.3%), petroleum and coal products (0.1%), and chemical products (0%) change very little in this simulation. No sector sees price increases larger than 2.7%. As a result of this even allocation of capital across sectors GDP declines by only 3.7%. Thus the 5.7% reduction in GDP in Table 2 is largely due to the heavy concentration of FDI in sectors such as motor vehicles, petroleum products, and chemicals.

Another reason for the relatively large impact of FDI on GDP is its effect on government spending. In the absence of FDI the economy would be smaller. We assume this results in less tax revenue and less government spending. We model this effect by linking GDP with government spending so that government spending as a share of GDP remains constant. As a result, the drop in government spending contributes to the decline in GDP.

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downstream sectors, government spending, and other indirect macroeconomic effects. As such we would expect our estimate of FDI's contribution to GDP to be larger.

To demonstrate this effect, consider a simulation in which we leave government spending unchanged. We can think of this as a sort of fiscal stimulus package, in which government makes up for some of the lost economic activity by increasing its spending as a share of GDP. In this simulation GDP declines by only 5.1%. Thus the 5.7% reduction in GDP is partly attributable to the effect of FDI on government spending. To put it another way, FDI contributes not only to private sector economic activity but also, through increased tax revenues via a larger economy, to public sector economic activity.

Finally, we turn to the employment effects of reduction in capital stock attributable to FDI.[12] As can be seen in Rows 3 and 4 in Table 2, FDI accounts for 6.0% of employment, or 8.5 million jobs. We interpret this result as the total direct, indirect, and induced jobs attributable to FDI in the United States. Of these 8.5 million jobs, BEA data show that approximately 6.1 million are directly employed in majority-owned foreign firms. The residual 2.4 million jobs are indirect and induced jobs attributable to the economic activity generated by FDI.

In summary, the USAGE model suggests that FDI accounts for only 3.3% of the economy's capital stock, but 5.7% of its economic activity, and 6.0% of its employment. The outsized economic impact of FDI is due to factors such as the uneven allocation of FDI across sectors, and the effect of FDI on government revenue and spending. In total, FDI contributes about 8.5 million jobs at prevailing real wages, of which 6.1 million are direct, and 2.4 million are indirect and induced.

In this section we used USAGE to measure the jobs attributable to the existing capital stock attributable to FDI. In the next section we use USAGE to measure the jobs attributable to technology spillovers associated with FDI over time.

[12] As the emphasis of this paper is on the jobs attributable to FDI, we do not focus on other macroeconomic results of our simulation such as imports (-5.1%) and exports (-6.4%). In fact, Ismaylov and Limes (2015) find that U.S. affiliates of foreign firms accounted for 23% of goods exports and 30% of goods imports in 2013. In addition, absent FDI, foreign firms would likely invest more capital in export-oriented production in their home countries. On the import side, research by Zeile (1998) demonstrates that foreign-owned businesses in manufacturing tend to have lower domestic content than other U.S. firms. All of these elements impact the trade effects of FDI in the U.S. We do not model the exports and imports attributable to FDI here. Rather we leave the trade effects of FDI as a direction for future research.

3. Jobs Attributable to Technology Spillovers Associated with FDI

3.1 USAGE Technology Spillover Simulation Methodology

FDI has long been suspected to be a major conduit of technology transfer. For example, Fosfuri, Motta, and Ronde (2001) find that technology spillovers occur as foreign affiliate workers with firm-specific knowledge assets are hired by domestic firms. Rodriguez-Clare' (1996) finds that foreign affiliates give access to specialized intermediate inputs. In this section we use the USAGE model to quantify the jobs attributable to productivity growth from technology spillovers associated with FDI.

Our modeling approach is to create a baseline simulation that models the business as usual economy in 2013. We then reduce total factor productivity in each sector by the amount we ascribe to FDI technology spillovers. Relative to the baseline each sector requires more inputs (labor, capital, and intermediates) per unit of output. This increases costs, which leads to higher prices and decreased output. As a result, the economy shrinks. With real wages fixed, employment must fall.[13] We interpret the aggregate change in employment as the jobs attributable to productivity gains from technology spillovers associated with FDI.

We make similar assumptions to the simulation in section 2 regarding real wages, government spending, and the terms of trade. The only methodological difference between this simulation and the one in section 2 is that we reduce productivity instead of capital stock.

3.2 Productivity Gains from FDI

In section 2 we modeled the jobs attributable to the existing stock of FDI at a single point in time. Changes in productivity, however, can only be measured over a period of time. For example, Keller and Yeaple (2009) find that between 1987 and 1996 FDI spillovers accounted for 14% of the annual productivity growth in the manufacturing sector. Goss, Wingender and Torau (2007) find that between 1988 and 1999 FDI was responsible for more than one third of the manufacturing sector’s productivity growth, and almost 16% of overall U.S. productivity

[13] Reducing productivity also has the effect of making these industries require more labor per unit of output, which increases demand for workers. Due to higher costs, however, the overall effect of productivity losses on employment is negative.

growth. Thus, our next task is to choose a time period over which to measure the impact of FDI on total factor productivity.

We adopt the methods of Moran and Oldenski (2013), who measure the impact of FDI on productivity growth from 1987 to 2007. They find that a one percentage point increase in the share of total employees in an industry who work at foreign-owned firms increases the productivity of all firms in the industry by an average of 3.56%. Between 1987 and 2007, employment at foreign-owned firms as a share of total private sector employment grew from 3.8% to 4.6% (a 0.8 percentage point increase). As such, they estimate that productivity spillovers from FDI were responsible for total factor productivity growth of about 2.8% (0.8*0.0356) over that period. Extending their calculations to 2013, when FDI employment reached 5.17% (a 1.37 percentage point increase from 1987), we estimate that FDI accounted for increases in productivity of about 4.9% (1.37*0.0356).

Finally, we need to determine which sectors experienced productivity gains from FDI. One option is to assume FDI increased productivity in all sectors by 4.9% from 1987 to 2013. It is unclear, however, whether sectors with high concentrations of FDI (such as manufacturing) experience more technology spillovers than sectors with less FDI. Sectors with few to no foreign firms (such as domestic air transportation or government) may not have benefitted from spillovers at all. Our solution is to simulate the productivity enhancing effects of FDI on the manufacturing sectors alone, leaving the jobs attributable to FDI productivity spillovers in other sectors as a direction for future research.

To summarize, we reduce total factor productivity in each of the 19 manufacturing sectors by 4.9%. We interpret the aggregate change in employment as the jobs attributable in 2013 to productivity gains from manufacturing technology spillovers associated with FDI over the past 26 years.

3.3 USAGE Technology Spillover Simulation Results

In this subsection we report the results of a simulation in which we reduce total factor productivity in each of the 19 manufacturing sectors by 4.9% in 2013. The macroeconomic effects of this loss in productivity are reported in Table 3.

Table 3: Economic Effects of a Reduction in Productivity Associated with FDI

Row	Economic Effect	Change
1	Economy-wide Productivity	-1.6%
2	GDP	-2.9%
3	Employment (%)	-2.5%
4	Employment (1000s of jobs)	-3,500

As can be seen from Row 1 of Table 3, the economy-wide productivity loss is 1.6%. This is a function of the manufacturing sectors' share of the aggregate economy. Collectively the 19 manufacturing sectors contribute about 33% to GDP. As a result, productivity losses in these sectors reduce economy-wide productivity by 1.6% (4.9%*33%).

This reduction in productivity results in a loss of economic activity of 2.9% (Row 2). Without the productivity gains from FDI, the economy is smaller, and can support less capital and less labor. With capital held fixed, employment falls by 2.5% (Row 3), a reduction of 3.5 million jobs (Row 4).[14]

In summary, productivity gains attributable to FDI in the manufacturing sector have contributed an estimated 1.6% to economy-wide productivity between 1987 and 2013. As a result of these productivity gains the economy can support an estimated 3.5 million more jobs at prevailing real wages.

4. Conclusion

In this paper we estimated the total jobs attributable to inward FDI in the United States, including direct, indirect and induced jobs.

In section 2 we modeled the jobs attributable to the existing foreign-owned capital stock in the United States. We found that in addition to the 6.1 million direct jobs reported by BEA, the existing stock of FDI contributes 2.4 million indirect and induced jobs, for a total of 8.5 million jobs.

[14] For more detail on the relationship between productivity and employment, see Appendix B: Linking Productivity and Employment in the USAGE Model.

In section 3 we modeled the jobs attributable to productivity growth due to technology spillovers associated with FDI. We found that over the past 26 years, in the manufacturing sector alone, productivity growth from FDI contributed another 3.5 million jobs.

Finally, we modeled both simulations simultaneously. We find that in total, 12 million people have jobs in the U.S. due to either direct employment at foreign firms (6.1 million), indirect and induced employment (2.4 million), or productivity spillovers (3.5 million) attributable to FDI.

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Appendix A. Reducing Capital Stock in the USAGE Model – An Example

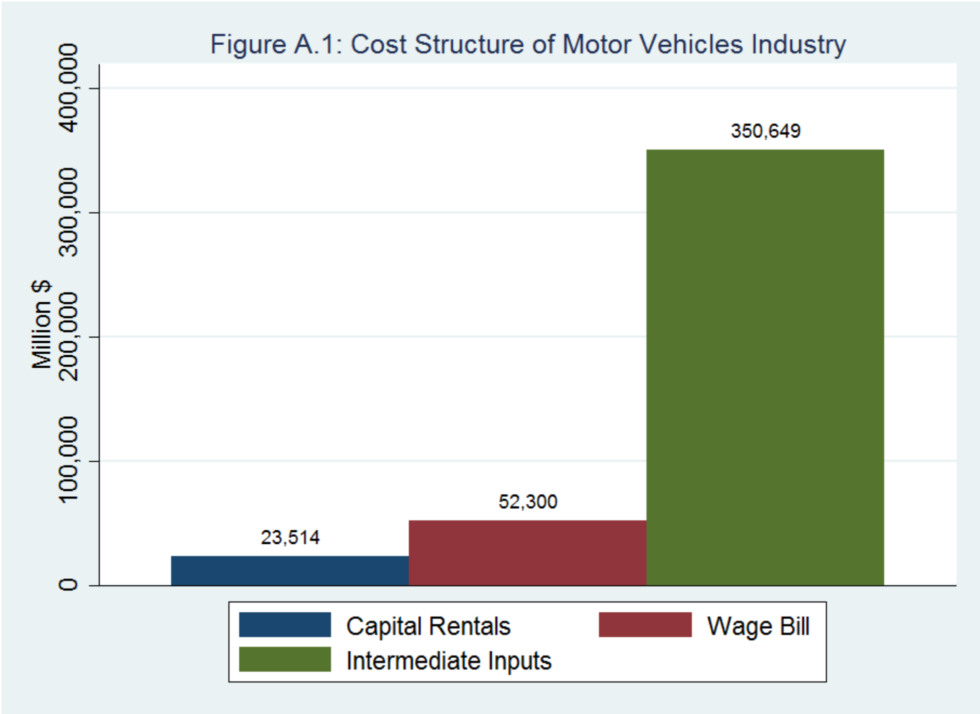
The number of jobs attributable to a sector's capital stock depends on a multitude of sector-specific factors. These include an industry's size, its labor intensity, its trade exposure, the sectors from which it sources its inputs, and the sectors that use its outputs.

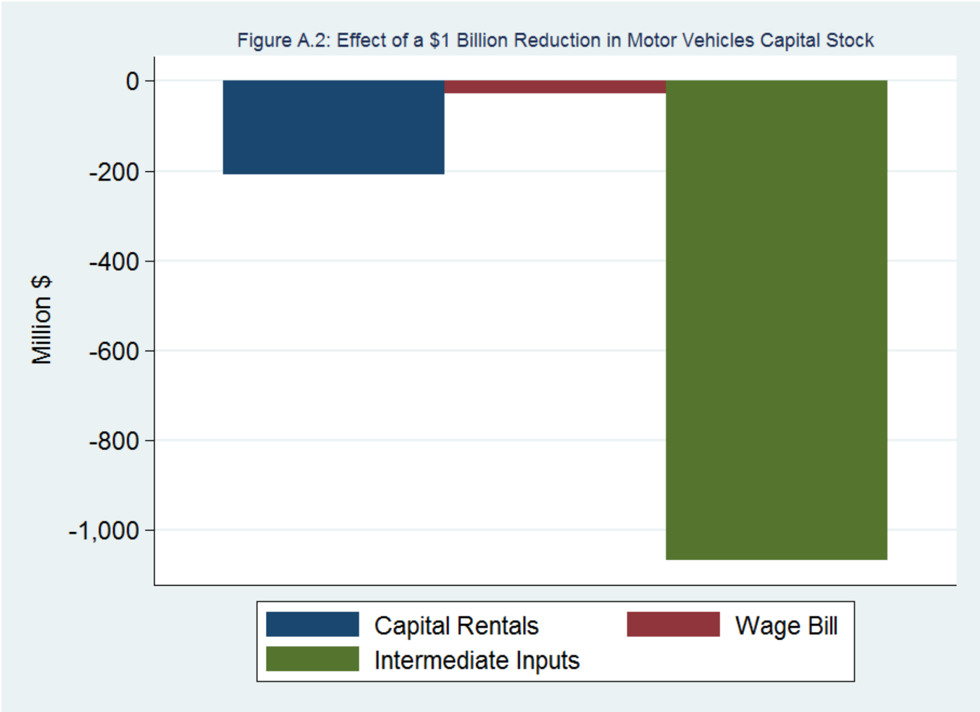
The interactions between these factors can be complex. For example, FDI in labor intensive sectors tends to contribute more direct jobs. However, FDI in a capital intensive sector may contribute more indirect jobs if it has more labor intensive suppliers. Disentangling the employment effects of each factor for each industry is a monumental task. USAGE, however, allows us to measure the net effect of these interconnected relationships.

To understand the economic impact of a reduction in capital stock in the USAGE model, consider a simulation in which we reduce the capital stock of the motor vehicles industry by $1 billion.

In 2010 this industry's capital stock was valued at about $112 billion. A reduction of $1 billion is a decline of about 0.9%. This leads to a roughly 0.9% reduction in capital rentals, which were about $23.5 billion in 2010 (Figure A.1).[15] Thus capital rentals decline by a little over $200 million (Figure A.2).

[15] In fact, the reduction in capital rentals is slightly more than 0.9%. As capital becomes scarcer its price rises. A 0.9% reduction in capital stock in this industry leads to an increase in the price of capital of about 2%. This results in a slightly larger reduction in capital rentals (which include these price changes) than capital stock (which, in this simulation, is a measure of the physical units of capital irrespective of price changes).





With less capital stock, output declines. As a result, this industry uses less labor and less intermediate inputs. Employment losses within the motor vehicles industry are somewhat mitigated by substitution from capital towards labor. However, this industry uses over $1 billion fewer intermediate inputs, many of which are sourced domestically from industries such as metal products and machinery. Consequently these upstream industries lose output and employment as well.

Less output in the motor vehicles industry leads to higher motor vehicles prices. This raises costs for downstream industries that purchase motor vehicles, such as transportation and construction, causing employment losses in those industries. Consumers face higher vehicle prices as well, which reduces household demand for a wide variety of goods and services. As a result of these and other factors, nearly every sector in the economy is affected. The aggregate economy-wide job losses from a reduction of $1 billion in motor vehicles capital stock is about 5,500 jobs. We interpret this as the number of jobs attributable to $1 billion of foreign owned capital stock in the motor vehicles industry.

Appendix B. Linking Productivity and Employment in the USAGE Model

In USAGE, the number of jobs attributable to a sector's productivity is largely determined by that sector's share of the aggregate economy. Manufacturing sectors, for example, contribute about 33% to GDP, the biggest industries being food, beverage and tobacco products (5.4%), chemical products (4.5%), and petroleum and coal products (4.3%). As a result, productivity gains of 4.9% in each of these sectors contribute about 1.6% to economy-wide productivity (4.9%*33%). These figures are reported in Table B1.

Table B1: Economy-wide Productivity Gains Attributable to FDI

NAICS	Industry	Sales/GDP	Productivity Gains from FDI	Contribution of Productivity Gains to GDP
321	Wood products	0.5%	4.9%	0.02%
327	Nonmetallic mineral products	0.6%	4.9%	0.03%
331	Primary metals	1.4%	4.9%	0.07%
332	Fabricated metal products	1.9%	4.9%	0.09%
333	Machinery	2.1%	4.9%	0.10%
334	Computer and electronic products	2.5%	4.9%	0.12%
335	Electrical equipment, appliances, and components	0.8%	4.9%	0.04%
3361MV	Motor vehicles, bodies and trailers, and parts	2.5%	4.9%	0.12%
3364OT	Other transportation equipment	1.6%	4.9%	0.08%
337	Furniture and related products	0.4%	4.9%	0.02%
339	Miscellaneous manufacturing	1.1%	4.9%	0.05%
311FT	Food and beverage and tobacco products	5.4%	4.9%	0.26%
313TT	Textile mills and textile product mills	0.4%	4.9%	0.02%
315AL	Apparel and leather and allied products	0.1%	4.9%	0.01%
322	Paper products	1.2%	4.9%	0.06%
323	Printing and related support activities	0.8%	4.9%	0.04%
324	Petroleum and coal products	4.3%	4.9%	0.21%
325	Chemical products	4.5%	4.9%	0.22%
326	Plastics and rubber products	1.2%	4.9%	0.06%
	Total	**33.2%**		**1.6%**

An increase in economy-wide productivity of 1.6% (***A*** in equation B.1, below) leads to an increase in GDP, allowing the economy to support more labor and capital (***L*** and ***K***).

(Equation B.1) $$\boldsymbol{Y = A \cdot F(K, L)}$$

With capital held fixed, the increase in labor is determined by the capital-labor substitution elasticity ($\boldsymbol{\sigma}$ in equation B.2), and the capital intensity of the economy ($\boldsymbol{S_K}$). The capital-labor substitution elasticity in USAGE is set at 0.4, based on the work of Chirinko, Fazzari, and Meyer (2004). With the economy-wide capital/labor ratio of about 37%, this would lead to employment gains of about 1.7% (1.6*0.4/0.37).

(Equation B.2) $$\Delta\boldsymbol{L = A \cdot \sigma SK}$$

The above calculation assumes constant government spending levels in dollar terms. As discussed in section 3, in our simulation we assume that government spending remains constant as a share of GDP. In other words, the economic benefits of productivity gains from FDI spillovers extend to government in the form of higher tax revenues. As a result of increased government spending from the economic activity generated by productivity gains, the employment impact is slightly larger (2.5% rather than 1.7%).

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