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Projected Jobs Supported by Exports, 2009 and 2010

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Executive Summary

The International Trade Administration's 2010 report "Exports Support American Jobs" provided preliminary estimates for jobs supported by exports for 2009 and for the value of exports that support one job for 2009 and 2010. The value of exports that support one job has been used as a metric to link jobs with export gains under President Barack Obama's National Export Initiative. Given the metric's prominence, this Economic Brief attempts to improve projections and to provide transparency in making the projections. It presents a new and better method and provides revised estimates for 2009 and 2010:

- The revised estimates of jobs supported by exports are 8.7 million in 2009 and 9.2 million in 2010. The revised number for 2009 increases the preliminary estimate by 200,000.
- The value of exports that supports one job was $164,000 in 2009 and $181,000 for 2010. That is, the value fell slightly from 2008 to 2009 (from $165,000 to $164,000) because of the recession and softness in export prices. In 2010, the value rebounded by $17,000, or 10 percent, to $181,000 as export prices and productivity strengthened.

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Projected Jobs Supported by Exports, 2009 and 2010

In 2010, the International Trade Administration published a report titled "Exports Support American Jobs" by John Tschetter.[1] The report provided estimates of jobs supported by exports and of the value of exports that support one job from 1993 to 2008. In addition, the report provided preliminary estimates of jobs supported by exports for 2009 and preliminary estimates of the value of exports to support one job for 2009 and 2010. Since the report's publication, the value of exports that supports one job has frequently been used in government press releases and reports to link jobs to exports in support of the National Export Initiative's goal to double exports by the end of 2014. This brief provides revised estimates of these numbers for 2009 and 2010. The estimates use additional details that have become available since the report was published and an improved method for predicting the information.

The method in the Tschetter (2010) report used nominal labor productivity to project trend increases in the value of exports that support one job. The new method, the *price/productivity method*, relies on predicting year-to-year changes in the value of exports that support one job. It uses variables that are more closely related to the value of exports that support one job than nominal labor productivity. In addition, two other methods were considered: *nominal business productivity* and *jobs to exports*. The nominal business productivity method uses nominal business labor productivity. The nominal business productivity and price/productivity methods start by estimating the value of exports that support one job and then calculate jobs supported by exports. The jobs-to-exports method estimates jobs supported by exports and then calculates the value of exports to support one job. It uses disaggregated information on exports of services and goods, employment by sector, and labor productivity by sector. From that information, it constructs jobs supported by sector by type of export.

Appendix A discusses why a change in model specification is recommended, why improved variable choices will better capture changes in the value of exports that support one job, and how the price/productivity and the nominal business productivity methods compare with the jobs-to-exports method.

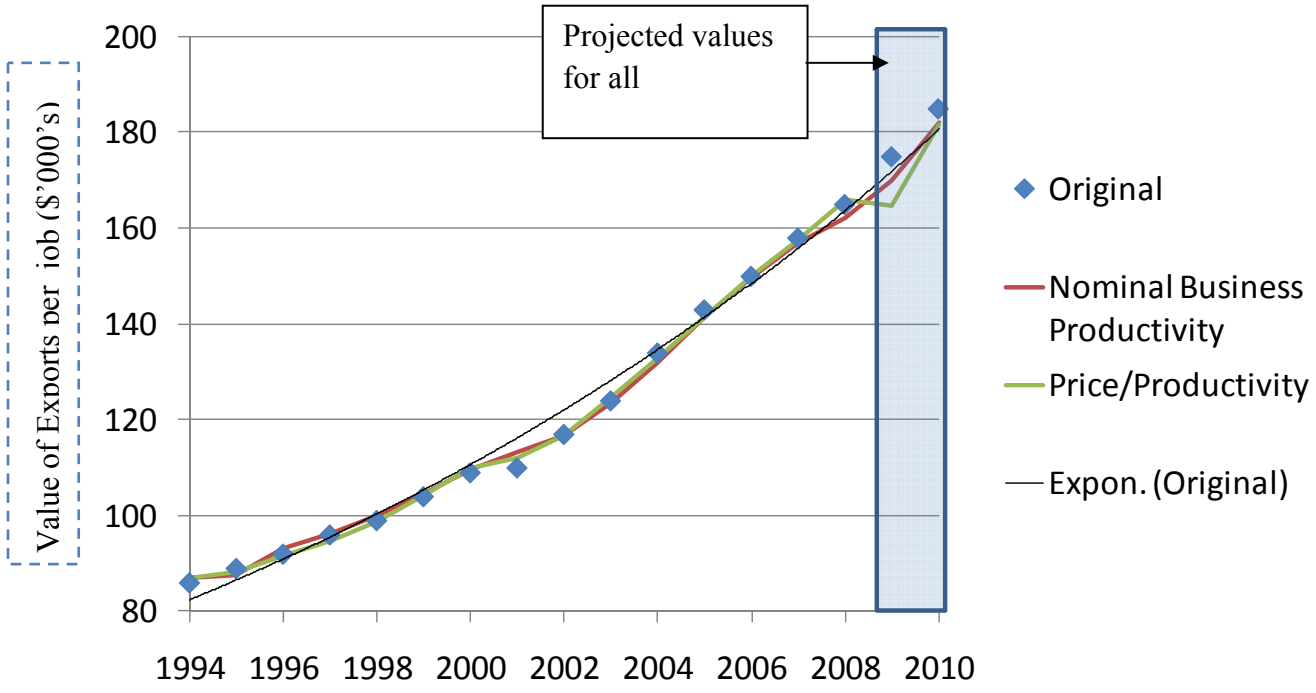
[1] Tschetter, John. 2010. "Exports Support American Jobs." International Trade Research Report No. 1, U.S. Department of Commerce, International Trade Administration, Washington, DC.

Appendix B contains a robustness check of how well the models can replicate historical values of exports to support one job. The check is especially important for the jobs-to-exports method because it has no underlying statistical measure of its ability to predict jobs supported by exports.

The price/productivity method is the best model for two reasons: (a) it controls for the effect of independent time trends in the data, and (b) it separates the value of exports that support one job into price and real productivity components.

To illustrate the improvements, this brief compares the historical values of exports to support one job (exports per job) to the price/productivity and nominal business productivity methods by drawing a simple trend line through the data (see Figure 1). Both the nominal business productivity and the price/productivity methods track historical values better than would a trend extrapolation, because they account for changes away from the trend.

Figure 1. Actual and Projected Values of Exports to Support One Job



Sources: International Trade Administration calculations and Tschetter (2010).

However, it is not obvious from Figure 1 whether price/productivity or nominal business productivity is the better method. Both are close to actual values. To deduce which method is better, one must quantify how well the methods match the values of exports that supported one job during 1994–2008. For comparison, the jobs-to-exports method is included.

Three points of comparison are used: accuracy, precision, and risk. *Accuracy* is how close the estimates are to actual values. Ideally, the average error is zero. The price/productivity method has the best accuracy (Table 1). *Precision* is whether the errors of one method are systematically closer than those of the others (that is, not only closer on average but closer every time). One measure of precision is the standard deviation. The standard deviation of the errors of the price/productivity method is less than that of the other methods. Finally, *risk* is the largest absolute error that is observed regardless of whether it is too high or too low. Even if a method is closer on average and is systematically closer than other methods, it should not be wildly wrong on some occasions. The price/productivity method is best by this measure as well. Because the price/productivity method is better at estimating the value of exports to support one job, it also is better at estimating jobs supported by exports.

Table 1. Errors in Predicting the Observed Value of Exports to Support One Job One Year Ahead

	Price/productivity	Nominal business productivity	Jobs to exports
Average error (accuracy)	$70	$160	$3,070
Standard deviation of error (precision)	$1,030	$1,510	$2,060
Maximum absolute error (risk)	$2,000	$3,230	$7,230

Source: International Trade Administration calculations.

As Table 1 indicates, the jobs-to-exports method was the worst-performing method. There are two reasons for its poor performance. First, the value of exports to support one job was calculated indirectly from jobs supported by exports. In contrast, the value of exports to support one job was the primary consideration of the other two methods. Second, the growth in the value of exports to support one job after adjusting for prices was consistently faster than what the available data would estimate. The other two methods could implicitly take this change into account by estimating an average rate of faster productivity growth.

Given the price/productivity method's superior performance, its results provide the revised estimates. As Table 2 shows, the revised numbers of jobs supported by exports in 2009 and 2010 using the price/productivity method are greater than the original estimates by about 200,000 jobs in both years. The increase in jobs supported by exports from 2009 to 2010 is the same, 500,000. In contrast, the values of exports to support one job are lower in 2009 and 2010 than the original estimates by $10,700 (6.1 percent) and $4,300 (2.3 percent), respectively.

Table 2. Jobs Supported by Exports and the Value of Exports to Support on Job

	Jobs supported by exports (millions)		Value of Exports to Support on Job	
	2009	**2010**	**2009**	**2010**
Original	8.5	9.0	$175,000	$185,000
Revised	8.7	9.2	$164,300	$180,700

Source: Manufacturing and Services/Office of Industry Analysis (MAS/IAN) calculations and Tschetter (2010).

Appendix A. Description and Evaluation of Estimation Approaches

Tschetter notes in "Exports Support American Jobs" that there is a strong correlation over time between nominal labor productivity and the value of exports to support one job (Table A.1). The R^2, which is the share of the variation in the value of exports to support one job that is related to nominal labor productivity, is high.

Table A.1. Correlation between Nominal Labor Productivity and the Value of Exports to Support One Job (R^2 = 0.983)

	Coefficient	Standard error	*t*-statistic	*P*-value
Intercept	−0.468	0.118	−3.977	0.001
Nominal labor productivity	1.062	0.024	44.223	0.000

Sources: MAS/IAN calculations from Tschetter (2010); Bureau of Economic Analysis (BEA) data from 1993 to 2008.

Some caution must be taken, however, in interpreting an R^2 relationship. If variables follow trends over time, regressions between them can have a high R^2 even when no relationship exists. As a preliminary step, one should test for a trend in the value of exports to support one job. As Table A.2 shows, this exercise finds a 4.6 percent trend increase per year and an equally high R^2 explained by the trend (0.984). Therefore, a second test is applied to ensure that the relationship is real and not just two variables following their trends.

Table A.2. Strong Trend Increase of 4.6 Percent a Year in the Value of Exports to Support One Job (R^2 = 0.984)

	Coefficient	Standard error	*t*-statistic	*P*-value
Intercept	4.384	0.014	315.250	0.000
Time	0.046	0.002	29.389	0.000

Source: MAS/IAN calculations from Tschetter (2010) for 1993–2008.

The second test checks whether year-to-year changes in the variables are related. If the variables' relationship is not real—that is, if it just reflects two variables following their trends—then no significant relationship will be found in their year-to-year changes. In addition, the R^2 of the year-to-year regression will tell approximately how much of the total R^2 is accounted for in year-to-year changes and how much is accounted for by trends. As Table A.3 indicates, the year-to-year relationship accounted for about one-third of the total relationship between the value of

exports that support one job and nominal labor productivity (the R^2 of 0.324 is about one-third of 0.983). The remaining two-thirds of their total R^2 is due to the individual variables following trends.

Table A.3. Ability of Year-to-Year Changes in Nominal Labor Productivity to Predict Year-to-Year Changes in Values of Exports to Support One Job (R^2 = 0.324)

	Coefficient	Standard error	*t*-statistic	*P*-value
Intercept	0.001	0.018	0.080	0.938
Year-to-year change in nominal labor productivity	1.053	0.422	2.496	0.027

Sources: MAS/IAN calculations from Tschetter (2010); BEA data for 1993–2008.

Given that nominal labor productivity accounts for only about one-third of the year-to-year change in the value of exports to support one job, one must wonder whether an alternative method would better match the value of exports to support one job. The first candidate tested was nominal business labor productivity.

Any labor productivity measure is an average of the labor productivity measures of its component labor groups weighted by the component's share in total employment. Nominal labor productivity gives government labor productivity a large weight because government employment's share of total employment is large. In contrast, relatively few government jobs are supported by exports, so government labor productivity's contribution to the value of exports to support one job is small. An alternative nominal productivity measure is nominal business labor productivity. The contribution of government labor productivity to nominal business productivity, by construction, is zero and closer to government labor productivity's contribution. The year-to-year regressions bear this out (Table A.4). The R^2 is larger (0.469 versus 0.324). But an R^2 of 0.469 still leaves most of the relationship to trends in the data.

Table A.4. Ability of Year-to-Year Changes in Nominal Business Productivity to Predict Year-to-Year Changes in Value of Exports to Support One Job (R^2 = 0.469)

	Coefficients	Standard error	*t*-statistic	*P*-value
Intercept	−0.002	0.014	−0.172	0.866
Year-to year-change in nominal business productivity	1.212	0.358	3.389	0.005

Sources: MAS/IAN calculations from Tschetter (2010); Bureau Labor Statistics (BLS) data for 1993–2008.

The price/productivity method recognizes that the value of exports to support one job is a measure of nominal labor productivity. Nominal productivity measures implicitly have two parts: price and real productivity. For example, the value of exports to support one job can increase because export prices increase, but it could also increase because real labor productivity increases (fewer jobs are needed to obtain the same quantity of exports). By using export price levels and a proxy for real export labor productivity, one can target each part separately and thus improve the estimates. Year-to-year changes in the value of exports to support one job are regressed on year-to-year changes in export prices and in real business labor productivity. The associated R^2, 0.717, is higher than the R^2 of the other regressions (Table A.5). Most of the changes in the value of exports to support one job can be explained by changes in export prices and real business productivity and not just by trends.

Table A.5. Strong Correlation of Yearly Changes in the Value of Exports to Support One Job with Yearly Changes in Export Price and Labor Productivity (R^2 = 0.717)

	Coefficients	Standard error	*t*-stat	*P*-value
Intercept	0.010	0.007	1.453	0.172
Year-to-year change in export price	0.699	0.140	4.982	0.000
Year-to-year change in business labor productivity	1.217	0.264	4.611	0.001

Sources: MAS/IAN calculations from Tschetter (2010); BEA and BLS data for 1993–2010.

The jobs-to-exports method does not directly estimate the value of exports to support one job. Rather, it estimates export-supported jobs by type of export and by sector of employment. The total number of jobs supported by exports and the total value of exports then implies the value of exports that supports one job. This disaggregated approach recognizes that exports can be goods or services, changes in export prices and export quantities may differ by type of export, goods and services exports use labor in different proportions, and labor productivity will differ by sector.

For example, both prices and quantities of goods exports were hit hard in 2009, but they rebounded strongly in 2010 (Table A.6). In contrast, prices and quantities of services exports were about one-third less than prices and quantities of goods exports in 2009 and, consequently, rebounded by less in 2010.

Table A.6. Changes in Export Price and Quantity from 2008

	Price change from 2008 (%)		Quantity change from 2008 (%)	
	2009	2010	2009	2010
Exports	−5.4	−1.4	−9.5	0.3
Goods	−6.8	−2.3	−12.0	1.3
Services	−2.2	0.6	−3.9	−1.8

Sources: Price change, BEA; quantity change, MAS/IAN calculations based on Census Bureau values net of reexports deflated by BEA price changes.

In addition, as Table A.7 indicates, the types of jobs supported by services exports are heavily tilted to jobs in the services sector. In contrast, the types of jobs supported by goods exports are tilted toward goods jobs but to a much smaller degree. Finally, labor productivity growth was much stronger in the goods sector than in the services sector. The jobs-to-exports approach accounts for differences in export prices, export quantities, job composition, and labor productivity.

Table A.7. Composition of Export-Supported Jobs (2008) and Labor Productivity by Goods and Services

	Job share (%)		Change in labor productivity from 2008 (%)	
Sector	Goods exports	Services exports	2009	2010
Goods	57.9	42.1	5.0	10.0
Services	14.3	85.7	1.7	5.0

Sources: Job share, calculated from Tschetter (2010) using figures 12 and 14; labor productivity, calculated from BEA and BLS.

The number of jobs supported by exports is calculated in four steps. The first step starts with the Census Bureau's reported values of exports of goods and of reexports. *Reexports* are imports of goods that are subsequently exported without being transformed (for example, cars off-loaded in the United States and exported to Canada). The value of reexports is subtracted from the value of goods exports because reexports likely support few, if any, U.S. jobs. The second step takes this adjusted value of goods exports and the Census Bureau's value of services exports and adjusts them by their respective changes in export prices to obtain real exports. For example, if the value of goods exports increased 20 percent but the price of such exports increased 10 percent, then the increase in real goods exports would be 10 percent. The third step applies the changes in real exports to the table of export-supported jobs by sector and by type of export to estimate the number of jobs supported by exports if there were no changes in labor productivity. To continue with the example, one would find that if there were no changes in labor

productivity, the 10 percent increase in real goods exports would lead to a 10 percent increase in the number of jobs in both sectors supported by goods exports. The fourth step is to apply the change in labor productivity by sector to the number of jobs by sector supported by each type of export. This step obtains an estimate of the number of jobs by sector supported by type of export. So, if labor productivity in the goods sector increases by 5 percent, then the goods sector would not need 10 percent more jobs to support a 10 percent increase in real goods exports—it would need only 9.5 percent more jobs to produce a 10 percent increase in goods exports.

The jobs-to-exports method leads to substantially more jobs supported by exports in 2009 and 2010 than was estimated in Tschetter (2010) (Table A.8). One factor contributing to this difference is that export prices were hard hit in 2009, so the nominal decrease in exports overestimated the decrease in the actual quantity of exports.

Table A.8. Jobs Supported by Exports Under the Jobs-to-Exports Method (millions)

	Jobs-to-exports method							
	2009 estimate				2010 estimate			
	Original method	Jobs-to-exports method			Original method	Jobs-to-exports method		
		Total	Goods	Services		Total	Goods	Services
Exports	8.5	8.99	3.64	5.35	9.1[a]	9.66	3.95	5.71
Goods	6.0	6.45	3.46	3.00	n.a.	7.08	3.77	3.31
Services	2.5	2.54	0.18	2.36	n.a.	2.58	0.18	2.40

Sources: Tschetter (2010), MAS/IAN calculation from Tschetter (2010), BEA data, and BLS data. Numbers may not add because of rounding.
a. Estimated from Census Bureau data for 2010 divided by $185,000, the value of exports to support one job in Tschetter (2010).

The 2009 estimates for jobs supported by exports using the jobs-to-exports method are bigger than the original estimate and those obtained by and nominal business productivity and price/productivity methods. Therefore, the implied value of exports to support one job is less than original estimate, and the estimates of the nominal business productivity method and price/productivity method. Tschetter (2010).

Table A.9. Substantial Reduction of the Value of Exports to Support one job in the Jobs-to Exports Method

	2009		2010	
	Original	Jobs-to-Exports	Tschetter	Jobs-to- Exports
Exports	175,000	161,300	185,000	173,600
Goods	n.a.	146,900	n.a.	160,200
Services	n.a.	197,900	n.a.	210,400

Source: MAS/IAN calculations from Tschetter (2010), BEA, and BLS data.

Comparing the original estimate of the value of exports to support one job to those from the three methods that allow for changes off trend, one finds that the recession took those values significantly below the trend estimates in 2009. However, in 2010, the values began returning to trend. If one compares the increase in jobs from 2009 to 2010, the three methods and the original estimate arrive at similar magnitudes of changes in jobs supported by exports—an increase of between 500,000 and 700,000 in jobs supported by exports (Table A.10).

Table A.10. Value of Exports to Support One Job and Jobs-Supported by Exports

Method	Value of Exports to Support One Job			Jobs supported by exports		
	2009	2010	Change (%)	2009 (millions)	2010 (millions)	Change (%)
Original	$175,000	$185,000	5.7	8.5	9.0	0.6
Nominal business productivity	$169,600	$181,000	6.7	8.6	9.3	0.7
Price/productivity	$164,300	$180,700	10.0	8.8	9.3	0.5
Jobs-to-exports	$161,300	$173,600	7.6	9.0	9.7	0.7

Source: MAS/IAN calculations and Tschetter (2010).

Although the revised methods provide similar results, the jobs-to-exports method approach has two potential advantages over the nominal business productivity and price/productivity methods. First, it provides disaggregated estimates of jobs supported by exports and values of exports to support one job by separating (a) goods and services exports and (b) goods and services sectors. Second, similar to the historical estimates from 1993 to 2008, it explicitly accounts for changes in the composition of exports and differences in export sectors that the other three, as models of total exports, cannot.

There are weaknesses in the jobs-to-export method, however. It uses more detail and, therefore, has more opportunities for errors. In addition, the jobs-to-export method is not statistically tested. Appendix B tests those weaknesses by checking how well the three methods can "project" the values of exports to support one job observed from 1993 to 2008 in the same way that they would project future values of exports to support one job.

Appendix B. Robustness Tests of Projected Value

The robustness tests discussed in this appendix aim to measure how well the three methods "predict," one and two years out, the historical values of exports to support one job given the information that would have been available in each year. These tests are necessary because there is a two-year delay in the release of BLS' input-output databases from which a historical calculation can be made and because there is a desire for more timely information on jobs supported by exports and the value of exports to support one job to measure the progress of the National Export Initiative.

For the price/productivity and nominal business productivity models, predicting historical values proceeds as follows. Observed values of nominal and real productivity and export prices are known in the year for which a prediction is made. Using those values in the regression equations, one can predict the percentage change in the value of exports to support one job. In the one-year-ahead projection, the predicted percentage change in the value of exports to support one job is applied to the previous year's observed value to project the current year's value. In the two-years-ahead projection, observed values of nominal and real productivity and export prices are known to obtain a predicted change in the value of exports to support one job. The predicted change is applied to the one-year-ahead projected value to estimate a two-years-ahead value.

Given that the price/productivity method is better than the nominal business productivity model in predicting the yearly change in the value of exports to support one job, one would expect that the one-year-ahead and two-years-ahead projected values would also be better. For example, the average errors for one and two years out are less. Also, with respect to precision, standard deviation is less (Table B.1). None of the statistical differences are significant, which is not surprising given the few observations, but the results reinforce the presumption that price/productivity is a better method.

Table B.1. Estimation of Historical Value of Exports to Support One Job Using the Nominal Business Productivity and Price/Productivity Methods

	Nominal business productivity		Price/productivity	
	1 year ahead	2 years ahead	1 year ahead	2 years ahead
Average error	$160	$210	$70	$160
Standard deviation of error	$1,510	$2,350	$1,030	$1,580
Maximum absolute value of error	$3,230	$4,050	$2,000	$3,010

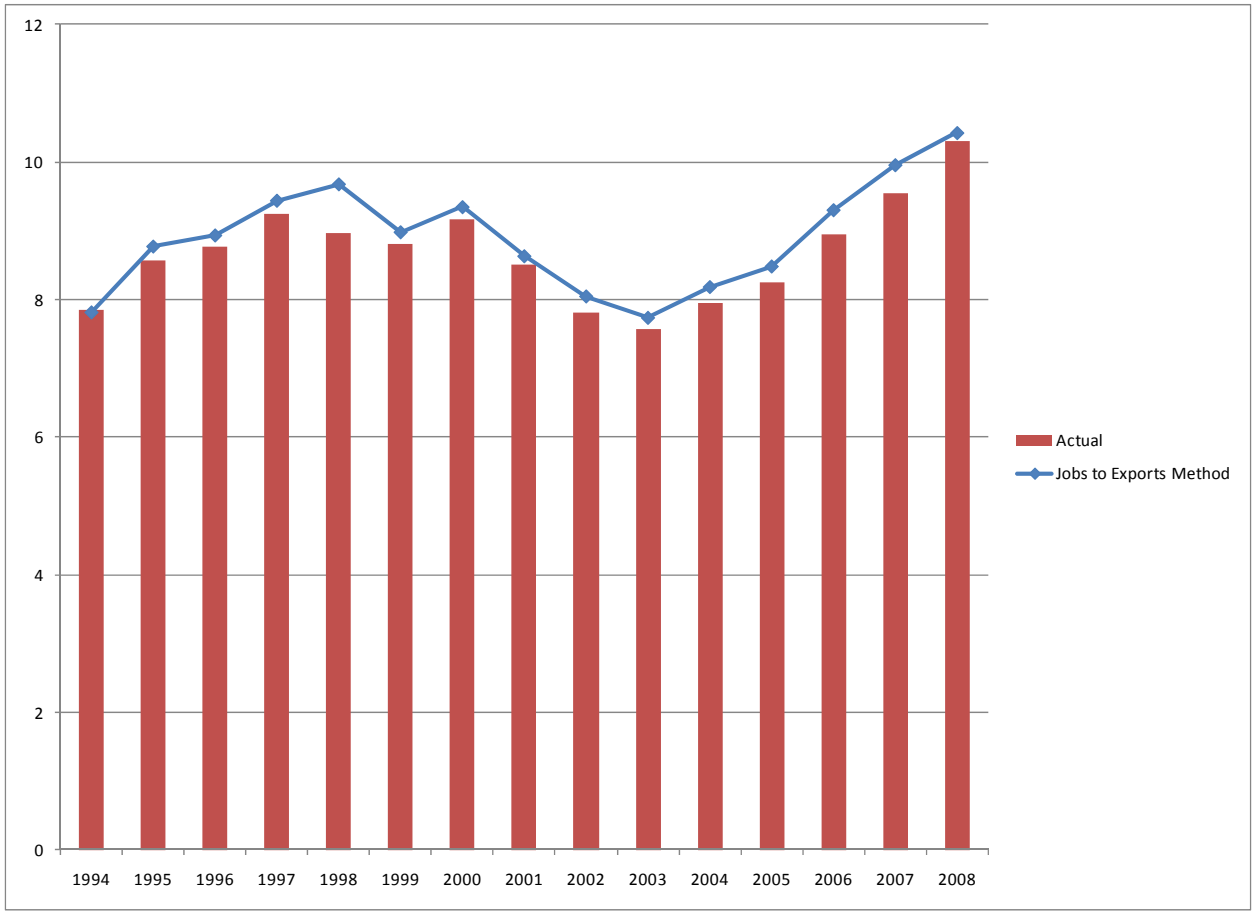
Source: International Trade Administration calculations.

The jobs-to-exports method relies on the value of exports net of reexports, price changes in exports to estimate real exports, and productivity changes to adjust the quantities of labor supported by exports. The robustness test for the jobs-to-exports method begins by checking whether, given Tschetter's (2010) export values for the year, an adjustment of export values for price and labor productivity changes, as discussed in Appendix A, would lead to projections that were better than either statistical method (that is, the nominal business productivity method and the price/productivity method). If the projections are worse, then adding another source of error from using the Census Bureau's export values would not improve the projections. Applying the robustness test, one sees that the jobs-to-exports method overestimates the number of jobs supported by exports in every year (Figure B.1).

The systematic errors undermine the robustness of the jobs-to-export method. In addition, it is unlikely that errors can be improved upon. Export price indexes (the first step) are not likely to be significantly biased by whether prices of reexports are included in the export price index. Consequently, the estimated change in real exports is not a likely source for the observed error. Observed productivity changes are available only at the higher levels of aggregations.

Because the jobs-to-exports consistently overestimates the number of jobs supported by exports, it consistently underestimates the value of exports to support one job. The resulting errors are quite large even at just one year ahead (Table B.2). Because the errors at one year ahead are so large, no attempt is made to calculate estimates for two years ahead. The price/productivity method, by implication, clearly outperforms the original method and the two alternative methods.

Figure B.1. The Jobs-to-Exports Method overestimates the Number of Jobs Supported by Exports (millions)



Source: IAN Estimates and Tschetter (2010).

Table B.2. Errors under the Jobs-to-Exports Method

	Jobs-to-Export Method
Average error	$3,070
Standard deviation of error	$2,060
Maximum absolute error	$7,230

Source: International Trade Administration calculations.

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