

Projected Numbers of Foreign Computer and Engineering Workers Under the Senate's Comprehensive Immigration Reform Act (S.2611)

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by

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ABSTRACT

This report presents projections of the foreign-born computing and engineering (C&E) workforce that recent Senate legislation could admit in the next one, two, five, and ten years. Most public controversy has focused on the Comprehensive Immigration Reform Act's (S.2611) process for resident undocumented aliens (passed last May 25, 2006). But there also are numerous reforms to highly skilled admissions. The projections suggest that the legislation could admit an immigrant computing and engineering workforce that is just more than 5 times greater than today's levels of admission. And the projection of immigrants under S.2611 exceeds the total foreign-born labor force in C&E that is consistent with projections of future employment demand by the Bureau of Labor Statistics. The legislation could admit foreign computing and engineering workers in numbers much greater than historical trends or casual assumptions about future employment.

The Senate's Comprehensive Immigration Reform Act of 2006 (S.2611), passed in May 2006, includes a far-ranging set of provisions. Although most public controversy has focused on the bill's tiered legalization process for resident undocumented aliens, there are numerous reforms of the highly skilled and student visas that would also have significant impacts on the future number of scientists and engineers.

This report presents projections of the foreign-born computing and engineering (C&E) workforce that S.2611 could admit in the next one, two, five, and ten years. The projections suggest that the legislation could admit a new immigrant computing and engineering workforce that is just more than 5 times greater than could be anticipated given today's levels of admission. The number of immigrants under S.2611 exceeds the total foreign-born C&E labor force that is consistent with projections of future employment demand by the Bureau of Labor Statistics.

Others have made projections of the number of immigrants that S.2611 would generate in the future. However, those projections are for *all* immigrants and do not specifically address the computing and engineering occupations that are the focus of this report.¹ Therefore, other projections of S.2611 cannot be compared to the projections presented here. The computing and engineering projections presented here are only for newly arriving immigrants, e.g., cumulatively from 2007 onward. And they are for employed workers *only* and do not include any family members that they may sponsor in the future.

Projection of S.2611 necessarily entails starting from the numbers that the legislation sets out. We want to know what the visa classes specified in S.2611 *could* result in, e.g., what immigrant numbers it would generate given a reasonable extrapolation of its stated intent. So the projections here balance the "all out" possibilities of S.2611's escalators, and many outside of caps admissions, with tempered assumptions. On the one hand, the projections start with the number of visas relevant to C&E workers implied in S.2611, using data-driven assumptions about future growth. On the other hand, projections are not made for all possible visas, or for all the possible increases, implied in S.2611.

¹ What is more, there is little commonality among the existing projections. They either include or do not include today's resident population in their long-term projections; they project for ten, twenty, and more years into the future; and they include varying assumptions about rates of emigration and family reunification.

Projections are made for C&E workers admitted with legal permanent residency; these are the single largest class under S.2611 and are mostly employment-based visaholders. Additionally, projections are made for the adjustment to LPR status of foreign students who graduate from U.S. colleges; and for graduates of colleges abroad with three years of U.S. work experience (as previous temporary H-1B visaholders). Projections are also made for the contemporaneous workforce of temporary H-1B visaholders in C&E occupations. These are the major visas affected by S.2611. All projections subtract from each future year's S.2611 admissions the number of individuals who die, emigrate, and drop out of the labor force.

But the projections do not include, although S.2611 permits, a yearly increase of 20 percent of temporary H-1B visaholders. Rather, the numbers are projected to grow in three-year increments to 198,000 or approximately the cap prior to 2003. Clearly, temporary intracompany transferees (L Visas), whose numbers currently rival H-1Bs, should also be included both as a temporary workforce and as LPR adjusters. However, there are no available data on which to hazard defensible assumptions for a projection of L visaholders. The projections also do not include S.2611 uncapped numbers for LPR first preference employment-based "priority workers." Also not included in the C&E projections are employment-based investors, or the old-diversity, or any of the family preference visas. The projections include a small percentage of employment-based spouses and spouses of citizens, but the numbers are very small because a downstream multiplier is not included.

The results demonstrate that S.2611 could generate very large numbers of newly arriving immigrant computing and engineering workers. Indeed, those numbers are many times greater than today's level of admission which has generated such significant growth of the foreign-born C&E workforce in the recent past. Whatever the varied motivations for S.2611—including a welcome improvement of immigrants' skill levels and streamlining of cumbersome admission processes—the legislation would admit foreign computing and engineering workers in numbers much greater than historical trends or casual assumptions about future employment levels.

THE S.2611 LEGISLATIVE CONTEXT

The trend in growth of the foreign-born in C&E occupations has been one of increasing numbers through the 1990s, followed by a stabilizing C&E workforce since 2000. The number of all computer and engineering workers as reported in Census data increased

153 percent in the 1980s and 167 percent in the 1990s.² These decade-to-decade rates of growth are much greater than that of the labor force overall, but the C&E workforce is relatively small being just less than 4 percent of the U.S. labor force. And as the U.S. labor force is about 150 million, it is worthwhile noting that in the context of the C&E workforce even seemingly small numerical changes may be significant.

The U.S. Bureau of Labor Statistics (BLS) most recent projections assume an increase in the C&E workforce from about 3.6 million in 2004 up to 5.8 million in 2014. That change represents a 125 percent increase in ten year's time.³ The BLS projections factor in future demand based on things such as GDP growth and technology shifts.⁴ Some of the past C&E projections by the BLS have been higher than those actually achieved (say for programmers and electrical engineers). Although a last round of projections through 2000 slightly underestimated the growth of all information technology during the unprecedented 1990s boom.^{5,6} Yet, the year 2000 may have been an interim high point for C&E employment as the workforce has not grown since then according to Census data (see Appendix Figure 1). These trends, and signs that the C&E labor force is not showing signs of extreme labor shortages, imply moderating assumptions about the pace of future growth. They also reinforce the BLS projections for very strong, but not as strong C&E growth as occurred in the 1990s.⁷

Yet, there is a perception that America either is losing a growing worldwide competition for highly skilled immigrants, or that business would benefit from yet more immigrants. Experts have voiced concerns about the pace of globalization and its implications for America's continued dominance of science and engineering.⁸ In some ways, it seems that

² Lowell, B. Lindsay and Mark Regets, 2006. "A Snapshot of Half of a Century: The STEM Workforce from 1950 to 2000," White Paper for the STEM Workforce Data Project, Center for Professionals in Science and Technology.

³ However, the BLS counts and those of the Census are not of the same magnitude. See Horrigan, Michael W., 2004. "Employment Projections to 2012: Concepts and Context," *Monthly Labor Review*, February, pages 3-22; and see <http://www.bls.gov/emp/>.

⁴ Daniel E. Hecker, 2005. "Occupational employment projections to 2014," *Monthly Labor Review*, November, pages 70-101.

⁵ McClure, George, 2006. "The Outlook for Workforce Demand," *Today's Engineer On-Line*, July, <http://www.todaysengineer.org/2006/Jul/outlook.asp>.

⁶ Alpert, Andrew and Jill Auyer, 2003. "Evaluating the BLS 1988-2000 employment projections," *Monthly Labor Review*, October, pages 13-37, <http://www.bls.gov/opub/mlr/2003/10/art2full.pdf>.

⁷ Monastersky, Richard. 2004. "Is There a Science Crisis? Maybe Not. Leaders Warn of a Labor Shortage in the U.S., but Indicators Point to an Oversupply," *The Chronicle of Higher Education*, July 9.

⁸ National Academy of Sciences, 2005. *Rising Above the Gathering Storm: Energizing and Employing America for a Brighter Economic Future*, by Committee on Prospering in the Global Economy of the 21st Century, National Academies Press. See also: National Science Board, 2004. *The Science and Engineering Workforce Realizing America's Potential*, Arlington: National Science Foundation.

the U.S. should do more to encourage high skilled immigration. The number of foreign students applying to U.S. institutions declined after 2001, although those numbers are now rebounding somewhat.⁹ The demand for high-skilled temporary specialty H-1B workers has exceeded the cap on visas for the past couple of years and the business community is asking for an increase in the H-1B visa cap. And President Bush in his 2006 State of the Union called for re-energizing our R&D enterprise and America's competitiveness. Furthermore, there are long-standing arguments in favor of tilting the admissions system toward more highly skilled workers who bring benefits and integrate more readily than low-skilled immigrants.¹⁰

At the least, the admission mechanisms for skilled immigrants are often cumbersome and, at times, unresponsive to rapidly changing labor market conditions and spot shortages. Consider the structure of the admissions system:

Legal permanent residents (LPRs) — legal “immigrants” or individuals and their dependents admitted under employment-based or family-based visa classes who may opt to become naturalized citizens after five years. Most C&E workers are admitted under the employment-based visas (EB Visas). There are occupational and skill requirements for employment-based admissions, but none for family admissions. There are “caps” or limits on the number of individuals who may be admitted in the various LPR visa classes, about 140,000 for all employment-based visas today.

Temporary students and workers (a.k.a. “non-immigrants”) — individuals and dependents admitted for defined purposes and whose visa specifies defined limits of stay in the United States. Students (F visas) are expected to leave after completing their studies; and workers (H-1B visas) after six years. However, it is estimated that the majority of such “temporary” visaholders ultimately become permanent residents; some two-thirds of foreign students and half of workers. Student numbers are not capped, while worker caps were once as high as 195,000 and now are set at the historical cap of 65,000.

⁹ Institute for the Study of International Migration, 2006. “Reason For Concern? Trends In The Numbers of Foreign Students in Science and Engineering Through 2005,” Brief, <http://www12.georgetown.edu/sfs/isim/pages/SloanProject.html#Anchor-Brief-9046>

¹⁰ Committee on Economic Development (CED), 2001. *Reforming Immigration: Helping Meet America's Need for a Skilled Workforce*, Washington, D.C.: CED, http://www.ced.org/docs/report/report_immigration.pdf; U.S. Commission on Immigration Reform (CIR) 1995. *Legal Immigration: Setting Priorities*, Washington, D.C.: U.S. CIR, <http://www.utexas.edu/lbj/uscir/>,

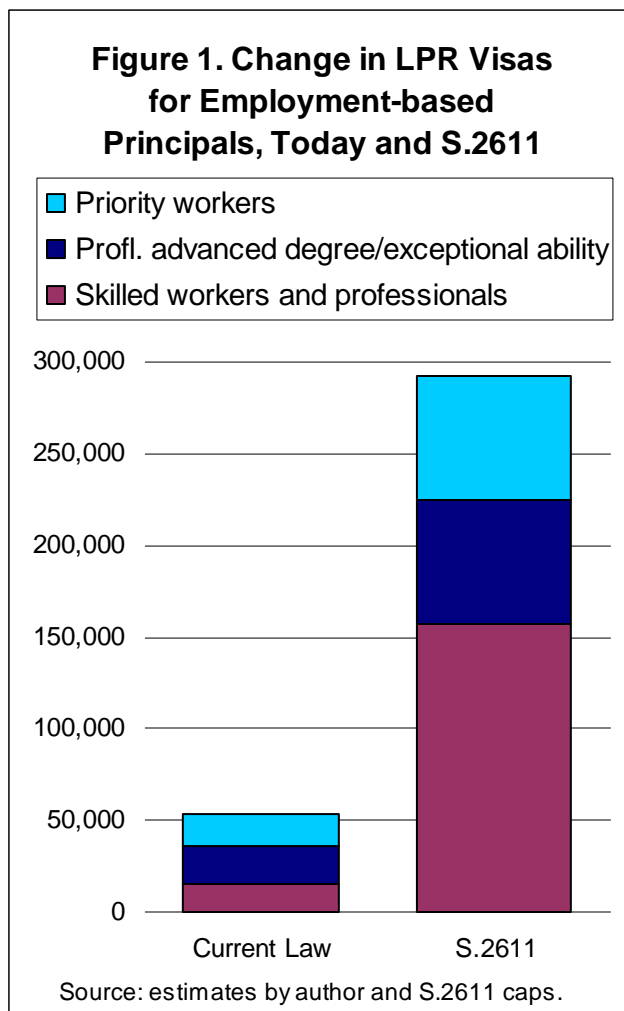
Admission rules — the LPRs require an employer sponsor whose job offer must be approved by the Department of Labor (DOL) that certifies that there is a shortage of domestic workers for the job. Certifications have historically taken up to four years, or very much longer than real world employment needs. Temporary foreign students are admitted for studies with comparatively little wait, while temporary workers are admitted in a few weeks after the DOL approves an employer’s attestation that certain working conditions will be met. Foreign students are not effectively barred from “adjustment” to LPR status, and temporary workers are explicitly permitted to adjust with LPR sponsorship.

THE S.2611 CHANGES

Doubtless, concerns about future competitiveness and a need to streamline the admission process have played a role in the Senate’s setting higher priority on highly skilled workers in S.2166. The language of S.2611 is sometimes vague and even conflicting, but it clearly provides major avenues for increasing the number of highly skilled immigrants. It increases employment-based admissions and makes particular allowance for scientific, technological, engineering and mathematical (STEM) workers:

- caps on *employment-based legal permanent* admissions are significantly increased,
- *foreign students* graduating from *U.S. institutions* with advanced STEM degrees are admitted with no cap,
- *foreign students* graduating from *foreign institutions* with advanced STEM degrees are admitted with no cap after three years of U.S. work experience, and
- *temporary specialty (H-1B)* visa numbers are increased with an annual 20 percent escalator if the prior year’s cap is exceeded.

Consider first the legal permanent admissions system. Figure 1 shows those employment-based visa classes that include most of the C&E workers admitted under today’s system and likely would continue to do so under S.2611 (Appendix table 1 shows a more complete accounting of S.2611 changes to the LPR admissions). Of course, family-based admissions are also increased, but none of these, with the exception of spouses of citizens, include significant percentages of C&E workers. Family preference visas are increased 112 percent under S.2611 while the citizen reunification visas would remain uncapped. Clearly, the family classes would increase sharply in the future as individuals earned legal status and, in turn, sponsored family members.



But the number of employment-based admissions is also substantially increased, by 270 percent. At today's levels of family immigration, S.2611 increases in employment-based and diversity immigration would briefly increase the highly skilled share of total S.2611 admissions from one-seventh to just less than one-third.¹¹

Note that there is a 452 percent increase in the cap on the EB-3 employment-based visas for skilled workers and professionals, one of the visa classes most likely to admit C&E workers. The number of EB-1 priority workers could well increase yet more than the apparent S.2611 because that cap would only apply to priority managers and not to priority scientists or engineers. At any rate, most immigrant C&E workers are likely to be admitted EB 1-3.

Figure 1 shows the effective increase in visas available for just principal immigrants (EB 1-3). The S.2611 specifies that EB visas are for principals and creates a separate visa class for dependents. The new S.2611 caps would permit the future growth of foreign workers that exceeds the trends of the recent past (current legislation) by some multiple equivalent to the increase in visas available for principals. In the case of the employment-based visas, S.2611 sets a number of visas about 5.5 times higher than current admission levels. It would be reasonable then to expect that S.2611 could lead to projections of skilled immigration of about this amount.

¹¹ The uncapped citizen reunification classes would increase beyond the levels shown here and, as a consequence, the proportion of employment-based admissions would decrease.

It is not as easy to guess at a likely multiplier for the number of new immigrants admitted under one of the other avenues noted above. We know that foreign students are a highly significant share of America's graduate classes and post-doctoral labor markets, but their absolute numbers relative to the labor market are small. Also, today's temporary H-1B workforce may be 500,000 or more—an estimate of all foreign temporary workers is about 704,000—and S.2611 would likely generate a yet larger H-1B workforce, a substantial fraction of whom would hold C&E jobs.¹² So future H-1Bs could contribute significant numbers to the C&E workforce during their tenure as “temporary” workers. Then they could contribute on a later, permanent basis after they adjust to LPR status via uncapped visas or through the so-called LPR preference visas which have numerical caps. This is not double counting, but unique counting of the same individual in different statuses.¹³ Thus, students and workers will be additional to the LPR admissions and S.2611 could be anticipated to increase the possible number of future C&E admissions to at least five times today's level of admission. Whatever the numbers, that figure must be estimated from trend lines and best estimates of the number of future C&E immigrants who are admitted as foreign students or workers.

THE PROJECTION METHOD AND ASSUMPTIONS

The projections undertaken here essentially start with S.2611 visa caps or admission/visa numbers and best estimates of the percentages of each visa class made up by C&E workers. The numbers of each year's C&E admissions are then extrapolated into the future, subtracting out “exits” from the population. The Appendix on Methods discusses the various assumptions and data sources used in the projections.

All projections must make assumptions and those made here start with the occupational composition of today's immigrants. In other words, the projections start with the percentage of a given visa class that are in C&E jobs today. That percentage is varied a little in future jobs in line with BLS projections of shifts in the importance of C&E occupations. The number of each year's C&E admission cohort is then decremented by mortality, emigration, and labor force participation.

¹² Lowell, B. Lindsay, 2000. "H-1B Temporary Workers: Estimating the Population," A Report for the Institute of Electrical and Electronic Engineers USA; and Grieco, Elizabeth M., 2006. "Estimates of the Nonimmigrant Population in the United States: 2004," Population Statistics, Department of Homeland Security, Office of Immigration Statistics.

¹³ The “temporary” workforce varies in size at each point in the future and workers exit it through mortality or emigration. They also exit the “temporary” workforce and are no longer counted in that workforce after they adjust to LPR status. More to the point, the C&E workforce is additively supplied by both avenues.

As for S.2611, the projections necessarily start from the visa levels that it specifies because this is the only way to evaluate what the legislation *could* produce. Yet, a literal reading could permit significantly higher projections than those made here. The greatest challenge is projecting the numbers that are *implied* in S.2611, primarily because it includes so many uncapped visas for science and engineering workers. Further, the projections here do not add downstream sponsored family members, many of whom would certainly be trained in computing or engineering.¹⁴ Therefore, the projection of the explicit numbers in S.2611 is tempered by not including all possible future immigrants.

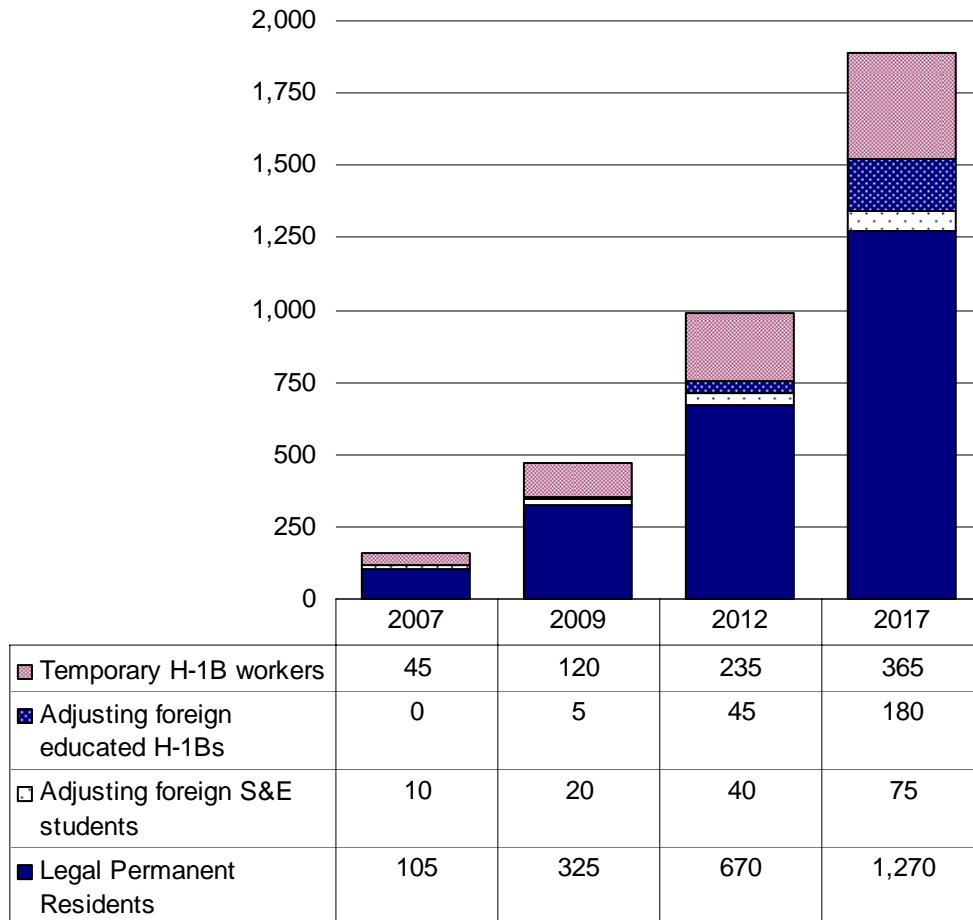
PROJECTIONS BY VISA CLASS

Figure 2 shows the projected C&E numbers of *all* immigrant LPR, students, and temporary workers under S.2611. In the first year of S.2611, given the number of visas it allocates, there could be as many as 155,000 C&E admissions. Those numbers of yearly admissions then would increase slightly each year into the future. But small increases on 155,000 accumulate into much bigger numbers with each succeeding year. In one decade, S.2611 could admit about 1.9 million foreign-born computing and engineering workers (see Appendix Table 2). Computing workers make up the greatest growth occupations of today's and tomorrow's science and engineering labor force. And they are the preponderance of immigrant C&E workers in these projections, reaching 1.5 million one decade after S.2611 is implemented. New immigrant engineers would total about 400,000 in one decade.

The projections indicate that the greatest number of future immigrants under S.2611 would be legal permanent residents admitted through the employment-based visas. The direct LPR employment-based admissions make up about 68 percent of future S.2611 C&E immigrants. Foreign students, assumed for the most part to adjust to LPR status outside of the capped employment-based visas, make up no more than four percent of future S.2611 admissions. Of course, these foreign students would have a substantial impact on the sectors where their employment is concentrated. Those foreign-educated workers adjusting to LPR status outside of caps do not start contributing sizable numbers for several years, but could contribute as much as 10 percent of the total. The workforce of temporary H-1B workers, on the other hand, could make up as much as one quarter of future new immigrant C&E workers.

¹⁴ Jasso, G., Massey, D., Rosenzweig, M., and Smith, J., 2000. "Assortative Mating among Married New Legal Immigrants to the United States: Evidence from the New Immigrant Survey Pilot." *International Migration Review*, 34:443-459.

Figure 2. Projections of the Cumulative Number of New Computing and Engineering Immigrants Who Could be Admitted Under Senate S.2611 by Visa Class (1,000s)



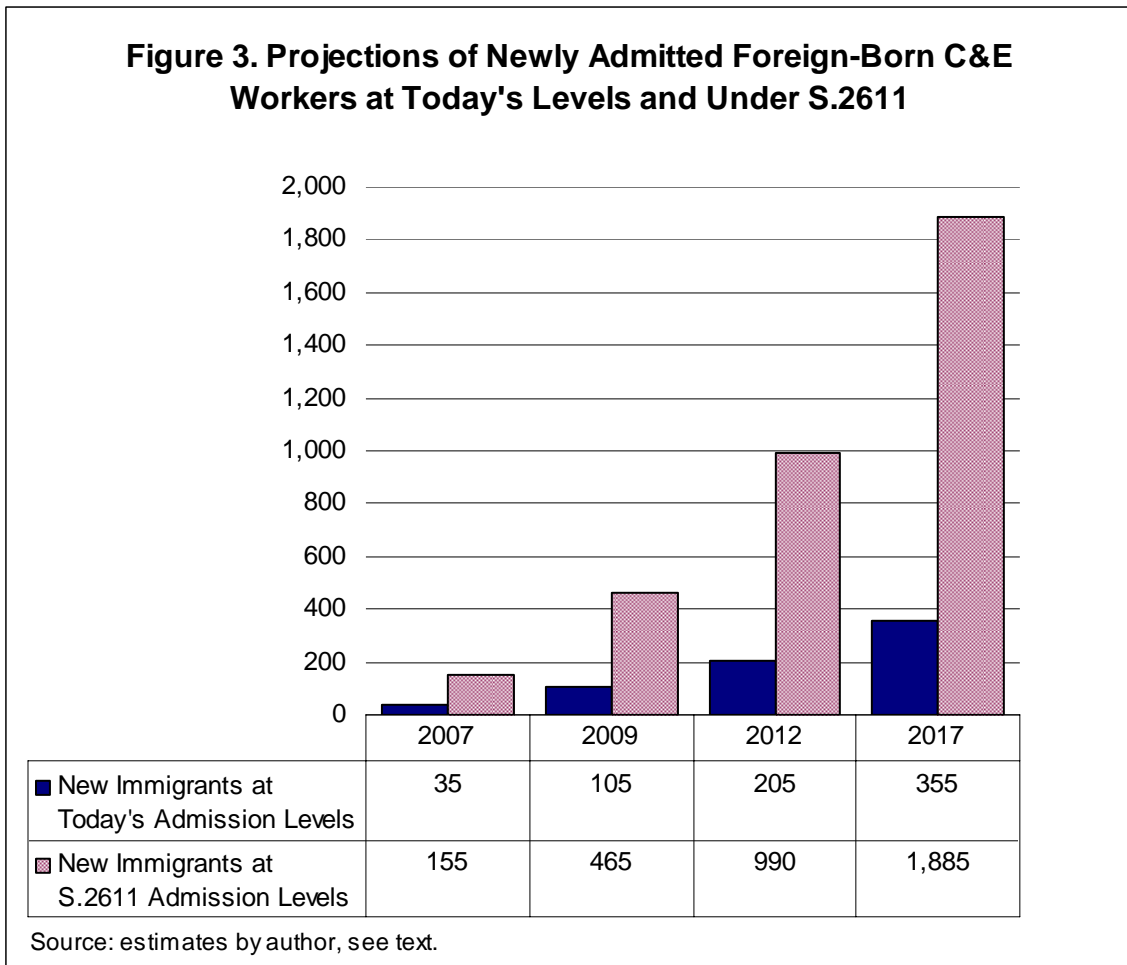
Source: estimates by author, see text.

COMPARATIVE BASELINE PROJECTIONS

It helps to understand the potential ramifications of the numbers that S.2611 could generate by comparing them to other baseline projections. First, we can compare the number of new, future C&E immigrants extrapolated from today's admission levels. Next, we can compare the S.2611 projections to the future demand for C&E workers projected by the Bureau of Labor Statistics.

Projections comparing today's admission levels. Figure 3 assumes that today's level of admissions hold into the future. Indeed, the S.2611 projections by themselves do not give us an idea of how many more C&E immigrants it could admit as compared to the current admissions system. Today's levels imply about 35,000 *employed* newly-arrived immigrant C&E workers in each future year at today's level of admissions. This starting admission cohort is about one-fifth the size of that projected under S.2611. Conversely, that means that the S.2611 legislation generates a yearly admission number that is about five times larger than today's level of admission of C&E workers. Unsurprisingly, this is consistent with the analysis that S.2611 increases the number of available visas at least fivefold. That ratio is what should be expected given our review above of the increases that S.2611 makes to visa numbers compared with current law.¹⁵

Figure 3. Projections of Newly Admitted Foreign-Born C&E Workers at Today's Levels and Under S.2611



¹⁵ Of course, the analysis of S.2611 actually generated a multiple of better than six. So the lower S.2611 multiple here may partly result from conservative projection results, possibly due to the several, unconditional decrements on the starting cohorts.

Projections compared to the BLS total. Another way to put these projections in context is to compare the BLS projections of tomorrow's labor force based on economic models of future demand. The BLS projections of the rate of C&E growth generate a *total* native and immigrant workforce of 6.2 million C&E workers in 10 years (2017).¹⁶ The BLS does not distinguish between native and foreign-born C&E workers in its projected demand. However, there is a way to make a reasonable division of the BLS total by nativity.

We can assume that today's native-born C&E workforce would grow at the same rate as the projected growth of American workers with at least a baccalaureate degree.¹⁷ The BLS calculates that a baccalaureate degree or better is needed to work in C&E occupations. And assuming that native C&E employment keeps pace with the projected numbers of college-educated natives is a fairly conservative assumption as native population growth is slowing somewhat. Again, while native's percentage of the C&E workforce decreased starting in the 1980s as the foreign-born percentage increased, both percentages and the C&E numbers have been stable since 2000 (see Appendix Figure 1).

Next, an estimate of foreign-born workers that is consistent with the BLS projections can be made. We can subtract the estimate of *native* workers from the BLS *total* and the difference (residual) is the implied number of *foreign-born* workers. Thus, the sum of the native projection and residual foreign-born equals (is no greater than) the BLS projected C&E workforce. The residual foreign born by this estimate is what would be needed after first accounting for a projection of native-born employment.

It turns out, by way of a separate cross-check, that this addition of projected native and residual foreign-born workers requires no additional immigrants over and above current visa numbers. The *separate* addition of the projected natives and that of future immigrants at *today's admission levels* (see Figure 3) *also* equals the BLS total. Both the residual projection and the projection of immigrants at today's admission levels amount to about the same number needed to meet the BLS total.¹⁸ Furthermore, under these scenarios the C&E workforce's share of foreign born continues to increase one third from 18 to 24 percent in one decade.

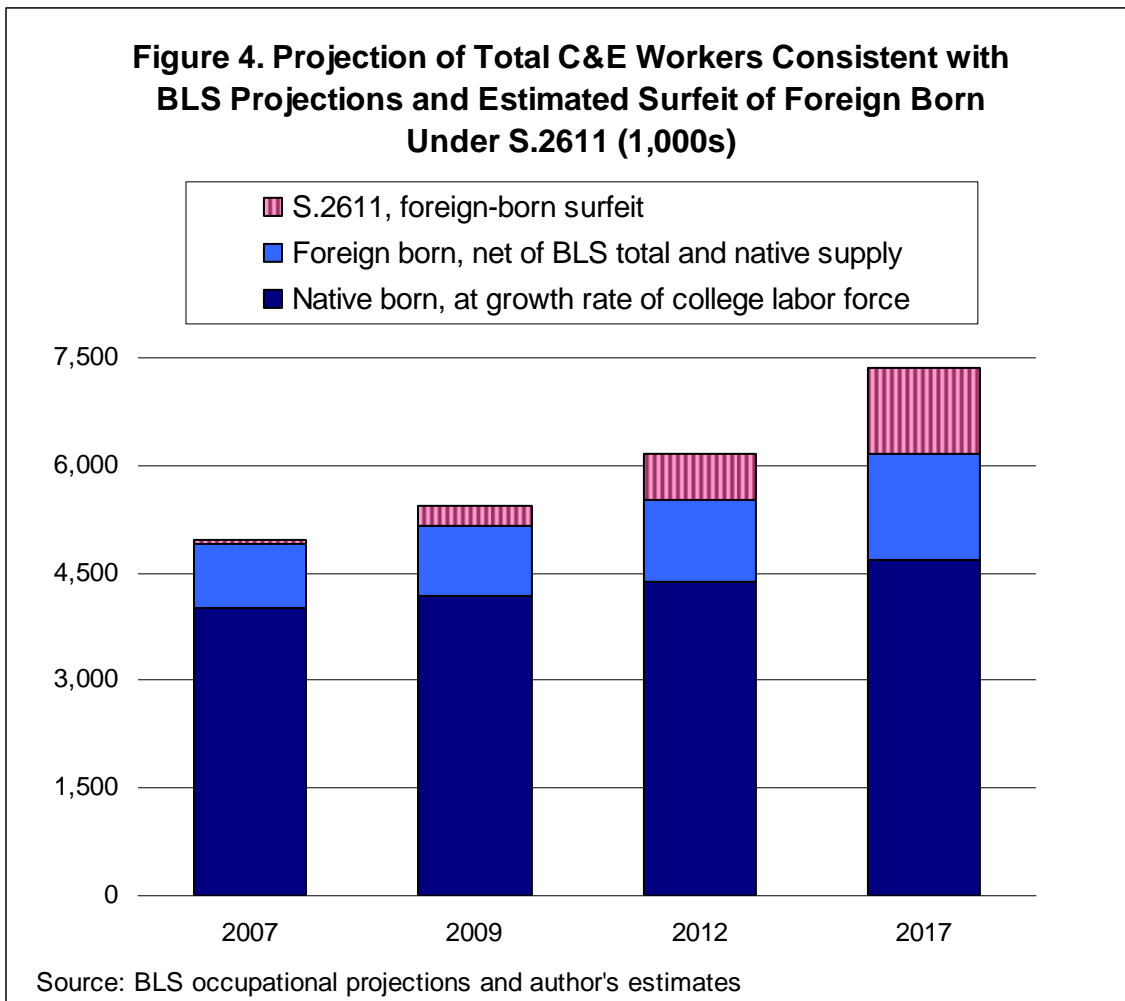
¹⁶ This figure is arrived at by applying a constant growth rate from the 2004 to 2014 BLS projections. See the BLS website for a discussion and data on the occupation projections (<http://www.bls.gov/emp/>).

¹⁷ I would like to thank Jeffrey Passel of the Pew Hispanic Center who provided projections of the native-born civilian labor force by level of completed education.

¹⁸ This calculation is made using the approach described below, e.g., the addition of projected native born, survived foreign born, and new immigrants at today's admission levels.

So the projection of S.2611 immigrants may be greater than the total demand that is consistent with the BLS projections. That possibility can be assessed by estimating a future foreign-born workforce that combines today's and tomorrow's new S.2611 immigrants. This requires that we first "survive" today's foreign born into the future which we do by subtracting out future mortality, emigration and retirement.¹⁹ The addition of the survived foreign born and the new S.2611 immigrants is then the total foreign-born expected under S.2611 projections.

Figure 4 shows that the number of foreign-born under the S.2611 projections is larger than the residual foreign-born estimate, e.g., S.2611 could generate a number of foreign



¹⁹ Natives are assumed to be about 82 percent of the BLS projected C&E labor force in 2004, or native's average share of the C&E workforce from 2000 to 2004. Today's foreign-born C&E workers, also estimated as their average share of C&E workers 2000 to 2004, is then "survived" into the future by applying cumulative rates of mortality, emigration, and yearly rates of retirement.

born that that exceeds the size of the BLS projections of *all* C&E workers. The lower two, dark bars in each figure show the estimated number of natives and foreign-born workers that sum up to the BLS projected total. The vertical lines running above these two segments show the projected number of S.2611 immigrants that exceed the BLS projections of *all* C&E workers.

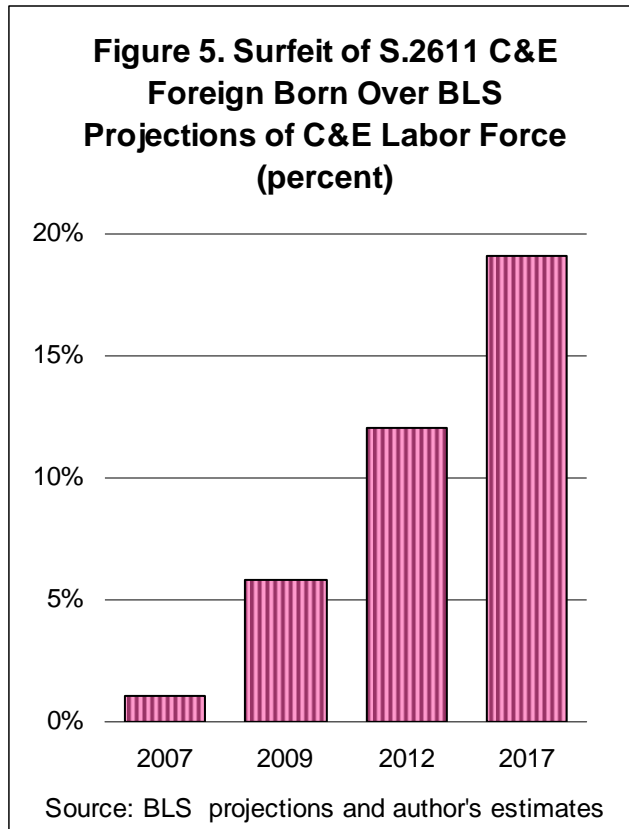


Figure 5 shows the estimated extra (surfeit) number of foreign-born C&E workers that S.2611 could generate in percentage terms. There is little change in the first year, but then the number of newly admitted foreign born begins to add up. Over time S.2611 could supply a greater number of foreign-born C&E workers than is consistent with the BLS projections. Five years after S.2611 visa caps go into play it could supply 12 percent more foreign-born C&E workers than BLS projections of demand. One decade out S.2611 could generate nearly one fifth (19 percent) more workers than the total number of C&E workers projected by the BLS.

CONCLUSIONS

The projection of new foreign-born computing and science workers under S.2611 suggests that the legislation could admit a foreign-born computing and engineering workforce that is more than five times greater than could be anticipated given today's levels of admission. Further, the number of immigrants under S.2611 exceeds the *total* foreign-born C&E labor force that is consistent with projections by the Bureau of Labor Statistics. By either measure, S.2611 would create a system that could admit many more highly skilled immigrants than the already very generous trends of recent years or what we might expect according to the nation's premier labor-statistics agency.

On the one hand, one could point out that these substantial S.2611 projections can only be realized if there is demand for these foreign-born workers. The S.2611 leaves employers in the driver's seat for the most part, as they must sponsor almost all future immigrant visaholders. Thus, if there is no demand, there is no reason to expect employers to drive the numbers as high as S.2611 obviously could permit. There are two important responses to this critique.

First, the immigration projections here are simply those which S.2611 *could* generate and that is a necessary exercise in evaluating its potential impact. If Congress legislates new visa caps it should expect those caps to be reached—not to do so is to vitiate the meaning of caps.²⁰ As far as the labor force and economy are concerned, visa caps are a means of managing the supply of workers in line with expected levels of demand. This is the tact taken by countries like Canada and Australia in setting their target admission numbers. But if caps are set without a regular assessment of demand, what would be the numerical impact? While numerical projections by themselves are not an analysis of economic or social impacts, they are a necessary tool to evaluate such impacts.

Secondly, the point of carefully set caps is to manage what might otherwise be self-escalating demand for visas. Indeed, the U.S. and international experience with setting visa numbers is that immigration tends to increase to meet caps. There are several possible reasons for caps to be self-fulfilling, but suffice it here to note that past caps for permanent and temporary admission have generally been reached. There is little reason, shy of a long recession, to expect that caps will not be reached.²¹

That leads to the question of whether or not there is the potential supply of foreign workers to fill these generous S.2611 visa numbers. Despite concerns that the U.S. is losing out in the international competition for highly skilled immigrant workers, the developing world has begun to move its burgeoning youth population into post-secondary education. All evidence is that the potential supply of secondary and post-secondary educated populations abroad will grow relatively faster than it has in the past. At the

²⁰ One long standing recommendation is that Congress revisit caps regularly to assess labor market conditions (Papademetriou, Demetrios G. et al., 1989. *The President's Triennial Comprehensive Report on Immigration*, Washington, D.C.: U.S. Department of Justice). Historically, caps are in place for decades and lack responsiveness to cyclical shortages, while potentially offsetting domestic responses.

²¹ Foreign born workers have lower reservation wages than natives and strong networks that smooth their supply. Observers have argued for alternatives to caps for regulating admission numbers. See Lowell, B.L., 2005. "Immigration as a Labor Market Strategy in the United States," pages 211 to 234 in Jan Niessen and Yongmi Schibel (eds.), *Immigration as a Labour Market Strategy: European and North American Perspectives*, Brussels: Migration Policy Group, <http://www.migpolgroup.com/publications/>.

same time, wealth inequality between the U.S. and the developing world has been widening and it is thought that it will continue to widen in the future. Whatever markets develop to absorb international workers in other nations, there will most likely be a plentiful supply of foreign students and workers keenly interested in coming to the United States.

APPENDIX METHODS AND ASSUMPTIONS

The projection of immigrant computing and engineering workers (C&E) under S2.611 is based on an equation that adds up the number of persons in successive admission cohorts. Each cohort size is estimated by the visa cap or the visa numbers permitted under S.2611, as well as its proportion of C&E workers (see below). The future numbers (t_{1+n}) of each cohort are then decremented for those who die, emigrate or leave the labor force:

$$C\&E t_n = \sum(C\&E t_{1+n} - M t_{1+n} - E t_{0+n} - NILF t_{1+n}) \dots$$

where, the cumulative number of immigrants is decremented by cumulative mortality (M) as estimated from National Center for Health Statistics;²² cumulative emigration (E) using USCIS estimates;²³ and specific year-after-arrival rates for those not in the labor force (NILF).²⁴

The initial cohort of computer and engineering professionals ($C\&E t_1$) is derived differently for each visa class as follows.

Legal permanent admissions. Each year's admission cohort of LPRs is assumed to be constant and is set by the cap specified under S.2611. The proportion of C&Es of LPRs is estimated from the 2003 New Immigrant Survey microdata for employment-based (EB) visas 1 to 3 (32 percent), diversity immigrants with advanced degrees (5 percent), and EB and citizen spouses (5 percent). The latter's numbers are conservatively assumed to be no greater than their 2005 levels and no spouse multipliers are estimated, despite the fact that today's C&E entrants will certainly naturalize in the future and sponsor future like-skilled spouses.

²² National Center for Health Statistics, Table 1. Life table for the total population: United States, 2003, <http://www.cdc.gov/nchs/deaths.htm>. Cumulative survival rates are applied to cumulated admission cohorts incrementally starting from each visa class' average age at admission (estimated from NIS data, see text).

²³ The LPR and adjusted F4/J-STEM and H-1B projections assume an emigration rate of 3.26 percent in the first year that decreases by five percent yearly thereafter (see Rytina, Nancy F. 2006. "Estimates of the Legal Permanent Resident Population and Population Eligible to Naturalize in 2004," Population Statistics, Department of Homeland Security, Office of Immigration Statistics). However, it seems likely that temporary specialty workers (H-1Bs) emigrate at a much higher rate than permanent residents. It is assumed here that H-1Bs emigrate at 5 percent each year (or the high rate of recent unemployment; and unemployed H-1Bs are required by law to leave the country).

²⁴ The NILF rates are estimated from Census 2000 5% microdata; see Steven R., M. Sobek, T. Alexander, C. A. Fitch, R. Goeken, P. Kelly Hall, M. King, and C. Ronnander, 2004. *Integrated Public Use Microdata Series: Version 3.0*. Minneapolis, MN: Minnesota Population Center (<http://www.ipums.org>).

Foreign F& J-STEM students. Each year's future admission cohort is estimated from a linear projection of MA and PhD temporary-visaholders by field of study who graduate from U.S. institutions.^{25,26} Of course, not all foreign graduates choose to stay in the United States and so their numbers are decremented by estimated rates of adjustment to legal permanent residency.²⁷ These latter adjustment rates are chosen to conservatively reflect an apparent plateauing of stay rates, but a shift of preference for transitions into LPR status as compared with H-1B.

Temporary specialty (H-1B) workers. Each year's future cohort is set by S.2611's beginning 115,000 caps for the first three years, followed by the permitted 20 percent increase in the cap for three years and then another three years, until a cap of 198,000 is reached. Those numbers are assumed to hold stable into the future. Clearly, the number of H-1Bs would reach astronomical levels if it were compounded at 20 annually. The 198,000 maximum is assumed because it roughly corresponds to the maximum petitions reached at the H-1B peak during the dot.com boom. Yet, it is very likely that H-1B numbers will increase because the S.2611 does not lift per-country preference admission caps. So just as it became a preferential route of admission in the later 1990s when LPR numbers were bottlenecked, the H-1B would likely become a holding class for later LPR adjusters. In turn, LPR adjustment rates are assumed to be 47 percent within six years, consistent with rates estimated for 1992 through 2003.²⁸ Of course, the C&E entry cohort

²⁵ National Science Board. 2006. *Science and Engineering Indicators 2006*. Arlington, VA: National Science Foundation, NSB 06-01.

²⁶ Although rather conservative, and similar to the approach taken by the Congressional Research Service, this generates a somewhat higher rate of growth for temporary visaholders than the NCES projects as the rate of growth for *all* PhD graduates. National Center for Education Statistics (NCES), 2005. *Projections of Education Statistics to 2014*. <http://nces.ed.gov/pubsearch/pubsinfo.asp?pubid=2005074> (see also Wasem, Ruth Ellen, 2006. "U.S. Immigration Policy on Permanent Admissions," Congressional Research Service, Library of Congress).

²⁷ Stay rates by field are estimated by Finn, Michael G., 2005. "Stay Rates of Foreign Doctorate Recipients from U.S. Universities, 2003," Paper prepared for the Division of Science Resources Studies of the National Science Foundation, Science and Engineering Education, Oak Ridge Institute for Science and Education. Finn estimates increasing stay rates that leveled off after 2001, and may be now declining somewhat. So we use the more conservative stay rates (63 percent) estimated for the 1997 graduate cohort of temporary visaholders. Further, Finn does not estimate how stay rates vary between LPR adjustment and change of status to H-1Bs (nor does he estimate MA stay rates). The latter are estimated by apportioning F adjuster numbers in USCIS admissions data (<http://www.uscis.gov/graphics/shared/statistics/yearbook/index.htm>) by graduate degree in the NIS green card sample; and then estimating the number of petitioners from U.S. colleges in the H-1B petitions data (<http://www.uscis.gov/graphics/aboutus/repsstudies/h1b/index.htm>). All estimated stay rates are estimated with a two-year lag of temporary visaholder graduates and are averaged over the five-years of available H-1B statistics. It is assumed that about three quarters of future stay rates will be into the uncapped LPR status; and that the overall C&E stay-to-LPR-adjustment rate will be roughly 52 percent for PhDs and 26 percent for MAs.

²⁸ Lowell, B. Lindsay, 2000. "H-1B Temporary Workers: Estimating the Population," A Report for the Institute of Electrical and Electronic Engineers USA, <http://www.ccis-ucsd.org/PUBLICATIONS/>

is estimated from the occupational distribution of initial entrants, estimated from the average of the 2002 and 2003 H-1B petitions statistics.

Baseline new admissions at today's levels. Each year's total cohort of immigrant C&E workers is assumed to be about 42,000 or the number of those admitted in recent years. This level is estimated from the 2000 Census microdata on first-year arrivals which compares favorably to estimates based on the 2003 NIS green card survey (weighted by 2003 admissions of persons reporting an occupation).

Pros and Cons of the assumptions. The entering cohort assumptions of the projections rely on today's immigrant occupational composition. However, it does not constrain those projections to be consistent with immigrant's share of any assumed labor force of tomorrow. Indeed, the projections end up exceeding past trends of immigrant shares within occupations.²⁹ These are the best assumptions that can be made, in lieu of non-existent methods for modeling the occupational distribution that might result from the "shock" of S.2611. What is more, this assumption is consistent with our intent to evaluate S.2611's future effects given today's inputs.

The data on mortality and emigration are the best available. The mortality schedule is not specific to the foreign-born population, but these are young populations and mortality has little effect. Emigration estimates remain very problematic as those used here are somewhat dated and not specific to country of birth. But while emigration is notable, it seems unlikely that better estimates would significantly change the implications of the projections made here.³⁰ At the same time, the labor force participation rates used here are as reasonable as one can get, shy of non-existent large longitudinal samples. The rates used reduce the numbers of those employed by 10 to 15 percent.

Another potential problem is the per country caps that S.2611 apparently leaves in place for most of the employment-based admission classes. The projections do not take into account the winnowing effect that per country caps would create and which could keep

[wrkg12.PDF](#). These estimates are updated through 2003. They do not include adjustments after the sixth year, which could add an additional 10 percent of the future H-1B population. Rather, the H-1B population is zeroed out after six years for each cumulated H-1B entry cohort.

²⁹ The occupational distribution, however, is varied somewhat by changing immigrant shares across occupations in line with the BLS's projected overall occupational shares.

³⁰ Van Hook, J., W. Zhang, F.D. Bean, and J.S. Passel, 2006. "Foreign-Born Emigration: A New Approach and Estimates Based on Matched CPS Files," *Demography*, 43(2): 361-382.

the 292,500 EB cap on highly skilled preferences from being reached.³¹ However, S.2611 increases per country caps from 7 percent of preference visas to 10 percent, or by 43 percent from today's base. And the number of C&E admissions under caps is estimated here to be only about 104,000 yearly which means the per country caps are not so much of an impediment. At any rate, there is no easy way to estimate the winnowing effect of per country caps and the intent of S.2611 clearly is to regulate admissions either through *overall* caps or by cap exemptions. The S.2611 permits foreign graduates with three years U.S. work experience to enter the U.S. *outside* of the cap. These would essentially be H-1B workers and the estimates here suggest that somewhere around 40,000 STEM qualified would be eligible to adjust yearly by 2017 outside of the cap. As for the H-1Bs generally, the visa could retain its current status of "LPR in waiting" with as many as 160,000 waiting to adjust by 2017. So if the projections err on the high side in assuming the EB slots are filled despite per country caps, they err on the low side in not separately including these H-1B adjustments (or the uncapped EB1 priority visas).

³¹ Note that per country caps are raised from 7 percent of preference visas to 10 percent, or very roughly from 22,000 to 31,000 per country. India, China, and the Philippines are the major sources of skilled migrants and they already push the limits on their per country caps.

Appendix Table 1. Number of Legal Permanent Immigrants Admitted by Current and S.2611 Visa Class

Permanent admission class	FY2005			S-2611			Change, %
	Total, number	Total, %	Class, %	Total, number	Total, %	Class, %	
<u>Total legal permanent resident (LPR) admissions¹</u>	1,122,373	100.0%	--	1,621,802	100.0%	--	44.5%
Employment-based preferences (EB)	148,449	13.2%	100.0%	450,000	27.7%	100.0%	269.8%
1 Priority workers	42,456	3.8%	28.6%	1 67,500	4.2%	15.0%	125.7%
2 Professionals advanced degrees or exceptional ability	42,456	3.8%	28.6%	2 67,500	4.2%	15.0%	125.7%
3a Skilled workers and professionals	32,456	2.9%	21.9%	3 157,500	9.7%	35.0%	451.9%
3b Needed unskilled workers	10,000	0.9%	6.7%	--	--	--	--
4 Special immigrants	10,540	0.9%	7.1%	--	--	--	--
5 Employment creation (investors)	10,540	0.9%	7.1%	4 22,500	1.4%	5.0%	180.1%
-- Other workers (formerly 3b)	--	--	--	5a 89,991	5.5%	20.0%	866.6%
-- Other workers, present before 2004	--	--	--	5b 44,996	2.8%	10.0%	--
-- Dependents	77,193	--	--	6 200,000	12.3%	--	104.1%
Diversity	50,000	4.5%	100.0%	55,000	3.4%	100.0%	10.0%
1a Diversity, high school	50,000	4.5%	100.0%	18,332	1.1%	33.3%	-63.3%
1b Diversity, advanced degree	--	--	--	36,663	2.3%	66.7%	--
Family-sponsored preferences (FB)	226,000	20.1%	452.0%	480,000	29.6%	100.0%	112.4%
Immediate relatives of U.S. citizens	436,802	38.9%	100.0%	436,802	26.9%	100.0%	--

Sources: Data on current FY2005 admissions are from the annual Yearbook of the U.S. Department of State and include dependents, http://www.uscis.gov/graphics/shared/statistics/publications/USLegalPermEst_5.pdf. Data on S.2611 are from the author's analysis of the legislation.

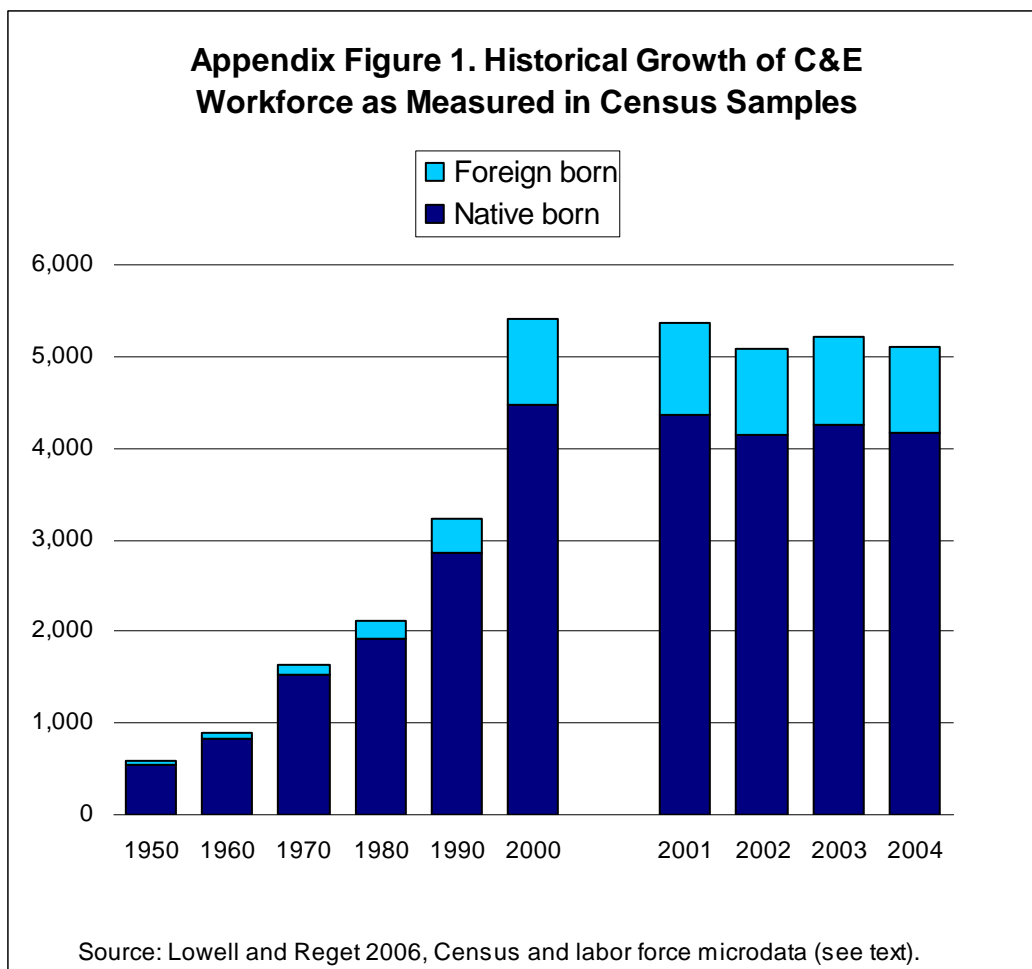
Notes: The legislated numbers on the current admission system differ in number but not proportion from those shown for FY2005. The figures in the table reflect the number of principals under S.2611. Under S.2611 the EB caps apply to principals only and a new EB dependents class is created. To estimate the number of EB dependents under current law the FY2005 numbers are multiplied by 52 percent which is the percentage of derivatives in FY2005 (about 48 percent of EBs 1-3 are principals which is used for the comparison in Figure 1). Not all categories are comparable (--). For example, the number of immediate relatives would surely increase substantially under S.2611, but the projections here make no assumptions about that growth.

Appendix Table 2. Projections of the Cumulative Number of New Foreign-Born Computing and Engineering Workers Who Could be Admitted Under Senate 2.2611 by Visa Class and Occupation (1,000s)

Visa Class & Year	Computer and math. Scientists	Computer Systems Analysts and Scientists	Computer Software Engineers	Computer Programmers	Engineers	Electrical and Electronics	Computer Hardware	Total Computer & Engineering Workers
2007	120	40	45	20	35	10	5	155
2009	360	115	145	60	105	25	10	465
2012	770	260	305	125	220	50	25	990
2017	1,480	505	605	220	405	95	40	1,885

Note: See text for projection assumptions. These figures include separate projections for legal permanent residents, foreign F and J STEM students, adjustment of H-1B foreign graduates to LPR status after 3 years US experience, and the workforce of temporary six-year H-1Bs. All projections are decremented for mortality, emigration, and rates of labor force participation. Numbers in subfields do not add to field total because all subfields are not included in the projections.

Source: estimates by author, see text.



These survey data collect self-reported occupation and for other technical reasons they are greater than the BLS figures shown elsewhere in this report. However, the trend in these data reflect the trend in the C&E labor force and the workforce shares by nativity can only be gotten from such microdata (these percentages are used in the projections). The figure is derived from tabulations of Census microdata for each decade from 1950 to 1990; and thereafter for yearly averaged Current Population Survey data 2000 to 2004.³²

³² For Census results see Lowell, B.L. and M. Regets, 2006. "A Snapshot of Half of a Century: The STEM Workforce from 1950 to 2000," White Paper for the STEM Workforce Data Project, Center for Professionals in Science and Technology, 2006, <http://206.67.48.105/index.cfm>; and for 2000 and beyond tabulations based on working age individuals in the CPS Merged Outgoing Rotation Group data, NBER, <http://www.nber.org/data/morg.html>.