

THE BROOKINGS INSTITUTION

IMMIGRATION POLICY:
HIGHLY SKILLED WORKERS AND U.S. COMPETITIVENESS AND INNOVATION

Washington, D.C.
Monday, February 7, 2011

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PANEL I - THE BEST AND THE BRIGHTEST IN ACADEMIA AND BEYOND

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P R O C E E D I N G S

MR. WEST: We are pleased to welcome to our gathering on Immigration Policy: Highly Skilled Workers and U.S. Competitiveness and Innovation. Foreign residents, students and entrepreneurs make valuable contributions to the U.S. economy, but what we're going to look at today is what should the U.S. do to capitalize on high-skilled workers, what kind of workers do we wish to attract and what policy changes should we consider to advance innovation.

Today we brought together some of our country's top talent on innovation and immigration. They will discuss each of their perspectives on how to keep top foreign students here and also the role of highly skilled workers in the area of technology and entrepreneurship. We also are putting out a paper this morning by Professor David Hart of George Mason University. I hope each of you picked up a copy as you were coming in. If not, we have copies outside in the hallway and you're welcome to pick one up on the way out. David is one of our country's most thoughtful writers on innovation and entrepreneurship. He understood some original work, some survey work on the role of immigrants in innovation and entrepreneurship and later on the second panel he will discuss where we are now and where we should go in the future. David, are you going to make some opening comments? I'll turn it over to you.

MR. HART: Thank you, Darrell. It's my pleasure to welcome you on behalf of the co-sponsor for this event, the Center for Science and Technology Policy at the School of Public Policy at George Mason University. For those of you who aren't familiar with the school, it's grown very big very fast and now has about a thousand students some of whom should be in the audience and it's a pleasure to see them. In January we opened a new building on Fairfax Drive in Arlington, and we're very excited about it. It's a great new facility for teaching and for events like this and it's also taller

than the law school which is next door, so we're excited about finally emerging from the shadow of the law school, not just figuratively but also literally. We hope that we'll be able to draw many of you assembled here in Washington across the river in the coming months and years, but of course we're also very pleased to partner with organizations on this side of the river and especially with Brookings. Darrell has also done work as many of you know in the field of immigration and high-skilled migration in particular and our shared interests, the kind of scholar-to-scholar exchange, is the sort of interaction I think that produces progress in policy research so that I'm very pleased to partner with him for this event.

Our purpose today is to give scholars who have active research projects in the area of high-skilled immigration, competitiveness and innovation the chance to share their ideas with you. It's a complicated and somewhat difficult topic and I don't think you'll find any easy answers here. There certainly is not consensus among the panel members today, but it is an issue that's rising in importance. I'm sure many of you saw the President's State of the Union where he mentioned the subject and that's very gratifying for us working in the field to get that kind of attention. I hope that you leave today with a variety of perspectives and some new ideas and hope you will continue thinking about this challenging set of issues. With that I guess I'm turning it back to Darrell to introduce the first panel.

MR. WEST: Our first panel is going to address the subject of the Best and Brightest in Academia and Beyond. We're pleased to have as moderator Mitch Waldrop. He is the news feature editor at *Nature*. Our panelists will include Robert Hamilton of the NASA Goddard Space Flight Center, Patrick Gaule who is a postdoctoral research fellow at the Sloan School of Management at MIT, Lindsay Lowell who is director of Policy Studies at the Institute for the Study of International Migration at

Georgetown University. And then I will be on the panel as well, so if I could ask our moderator and panelists to come up.

MR. WALDROP: Good morning, everybody. Thank you for coming. David asked me to do this in a slightly different order than is listed in the inside of the program. We're going to do it as on the front side of the program. Let's begin with Bob Hamilton.

MR. HAMILTON: Good morning. My presentation is focused on doctoral degree attainment by foreign students at U.S. universities in the science and engineering fields. This can be considered as a form of highly skilled migration for the purposes of education. The findings presented here are from a paper co-authored by myself and my two colleagues from George Mason University, Connie McNeely and Wayne Perry, and thanks to the National Science Foundation for their data support.

On a personal note, I first became interested in immigration and education in 1989. I had just gotten out of the Marine Corps and I traveled to Tokyo to study Japanese at a language school. There were not too many Westerners in the school, mostly Korean and Chinese students, and none of the students spoke English so that we had a great chance to communicate only in Japanese. This was a tremendous experience, but from the experience I also gained a great respect for those who leave their friends and family for many years to pursue education in a foreign country.

Again my talk focuses on science and engineering doctoral attainment at U.S. universities and the time period covered in this study is 1994 to 2005. Doctoral attainment data was collected from foreign students representing 181 nations and the 5 fields that I study are physical sciences, life sciences, engineering, mathematics and computer sciences and the social and behavioral sciences. During this 12-year period as the screen shows, the count was 96,466 foreign doctorates in the science and

engineering fields at American universities, so let's just say generally 100,000 students during this 12-year time period attained their science and engineering doctorates at American universities.

Let's talk about a conceptual framework for the talk this morning. This conceptual framework is offered to help better understand the phenomenon where foreign students travel to the United States for their science and engineering doctoral degrees. First of all, you can visualize a foreign student pipeline from each of the 181 nations to U.S. universities but also realize that these same pipelines or similar pipelines from these 181 nations also extend to other nations with degree granting universities such as Australia, Canada and European nations. Therefore, the student pipelines to U.S. universities can be viewed as only one component of a global student migratory network and, further, these student pipelines to the United States appear to be facing growing competition from other nations desiring the best and brightest foreign students of the world to attend their home nation universities.

It is also helpful to view home education, that is kindergarten through twelfth grade and university education in terms of a domestic student education and screening pipeline at work prior to foreign students coming to the United States. All said, these foreign students who have attained their science and engineering doctorates in the United States have traveled a tough road. First they had to pass the often-challenging domestic education, screening and selection process and then they had to compete with other foreign students to gain admittance at a U.S. university.

Let's talk about the role of U.S. universities. As for U.S. universities, they have played a greater role beyond educating and training foreign science and engineering doctorates. The university should also be viewed as a global recruitment and quality-control mechanism that screens and selects the best and the brightest of the

world's foreign students for admittance into doctoral programs. It should also be noted that the U.S. taxpayer has not for the foreign student's kindergarten through 12th and undergraduate university education in that the home nation picks up the bill for this. It seems that the United States has gotten a pretty good deal, that is foreign governments pay to educate their home nation students and then U.S. universities have the pick of many of the best and the brightest for their own science and engineering doctoral programs.

Let's talk a little bit about the role of the U.S. Government. As for the U.S. Government, it highly subsidizes doctoral education to include that for foreign students the rationale being that there are public benefits resulting from this type of education and that research, development and innovation will suffer if students are not offered government incentives to stay in the doctoral pipeline a few years more. The U.S. Government also issues student visas and it should be noted that the student visa pipeline was disrupted due to the 9-11-2001 terrorist attacks prompting the U.S. Congress to take an interest in helping to establish a new student visa tracking system. Further, foreign doctoral students also appear to benefit universities in a situation similar to on-the-job training where these foreign students are employed as relatively low-wage, highly skilled research assistants while they pursue their doctoral degrees.

As stated, foreign doctoral attainment at U.S. universities is a case of highly skilled migration and what seems to have generated policy interest has been the relatively large increase in the presence of foreign doctoral students on U.S. campuses in recent years. For example, as the chart shows in 1980 there were less than 3,000 foreign science and engineering doctorates attending American universities. The number exactly is 2,842. As you see, this represented only 16 percent of the total meaning that 84 percent of science and engineering doctorates attained at U.S. universities in 1980

were attained by U.S. citizens. Again as you see on the chart, the numbers change from 1980 to 1994 to 2005, three reference points. In 1994 the numbers increased to almost seven thousand which is 6,950, and by 2005 the numbers exceeded 11,000 and this number increased foreign-student representation to almost 40 percent of all doctorates attained at American universities.

As the next slide shows, it should be noted that there is variation between the five fields. For example, and this is for 2005, as the chart shows you see great foreign domination of the engineering field of doctorates where 61 percent of all doctorates in 2005 were attained by foreign students. On the other end as the spectrum as you see in life sciences, only 28 percent of the doctorates in life sciences were attained by foreign students meaning 72 percent if my math is correct of all doctorates were attained by U.S. citizens. You can the variation here. My point is that if we want to study this phenomenon, let's disaggregate. Let's talk about the five different fields. As you notice also in social and behavioral sciences, only 21 percent were attained by foreign students which means that 79 percent were attained by U.S. citizens.

The findings of the study are that four nations dominate in science and engineering doctoral attainment for the years 1994 to 2005. The nations are China, India, South Korea and Taiwan. If you look at China and India, I think it's fairly apparent that these are large population countries and the reason there are many Chinese and Indian science and engineering is that there are large home nation populations. I think what's interesting is the outliers here are South Korea and Taiwan. With relatively small populations of both of these nations, there were about ten-thousand science and engineering doctorates attained during this time period. As to why are there so many Chinese and Indian science and engineering doctorates, I think a more interesting question is why there were so many South Korean and Taiwanese doctorates during this

time period. However, as time period progressed from 1994 to 2005 you see that the Chinese numbers increased dramatically, the Indian and South Korean numbers were fairly static and the Taiwanese showed a large decrease.

This chart shows the change in Chinese doctoral attainment from 1994 to 2005. If you can't see the screen, let me talk about this. In the engineering field in 1994 only 136 engineering doctorates were attained by Chinese students. By 2005 the number had increased more than tenfold to a little over 1,500 which is a tremendous increase. The share of the Chinese doctorates among the foreign population also increased, as you see in the physical sciences, 36 percent, life sciences 32 percent, engineering 39 percent and math and computer science 39 percent. As you'll also notice, the Chinese representation in social and behavioral sciences is fairly small. I think the idea is that Chinese students are less likely to become economists and social scientists and more likely to become chemists, engineers and physicists.

Let's talk about engineering one more time. If you look at a 39 percent share in 2005 for Chinese engineers and a 61 percent share for all foreign students, what means in 2005 is that 1 out of 4 doctorates in American universities were attained by Chinese students. A question for me is why are so many engineering doctorates on the one hand being attained by foreign students and so few being attained in the life sciences compared to U.S. citizens?

In closing, the best and brightest of the world's science and engineering students from emerging-market nations like China, India, Russia and Turkey, for example, will probably become an increasingly prized human resource to be recruited and competed over by developed nations with lower birth rates and decreasing pools of talented young people. The United States should keep this in mind when formulating its own highly skilled migration policy. Thank you.

MR. WALDROP: Thank you very much, Bob. That was fascinating. We'll hold Q&A to the end I believe. Patrick, I believe you're next.

MR. GAULE: What I would like to do is to talk briefly in a very nontechnical manner about two recent research papers I've been working on. The first one is about Chinese graduate students on U.S. productivity -- and then time permitting, I'll say a few words about another project.

The previous speaker was very helpful in giving lots of motivation for the paper I'm going to present. Let me show you yet more numbers along the same line. If you look at the population of P.G. students who finish P.G. degrees in the United States and you look at where -- got a degree, you will be surprised that there are more students that come from -- University in China or Beijing University than from Cornell and Berkeley. I repeat this because it's quite surprising if you take someone who finishes a Ph.D. degree from a U.S. university in science and engineering, he is more likely to have done his Ph.D. degree at Beijing University than at Berkeley or any other U.S. institution. This is slightly misleading because there are many good U.S. universities and not that many that good Chinese universities and once you keep in mind the figures that were presented earlier, the Chinese students are about 15 percent of students graduating from U.S. universities is still quite a large number.

Overwhelmingly Chinese students stay in the U.S. after their Ph.D. degrees -- is that we see a relatively sizable fraction of the science and engineering workforce is born in China, so about 9 percent of doctorate -- U.S. science and engineering occupations were born in China as of the 2000 census. If you take all foreigners together it's about 47 percent.

The literature on the contributions of the foreign born to U.S. science, one of these papers is by Jennifer Hunt who is on the other panel. I'm not going to

engage into a discussion about exactly the respective contributions of these papers, but what's more interesting is that all of these papers came to the same conclusion which is that migrants make disproportionate contributions to U.S. science and engineering and tend to be more productive on average than natives when looking at the area of highly skilled scientists and engineers.

In my own work I have quite similar but a bit more specific about the students. What we are asking now is the scientific output of the Chinese students during their theses compared to that of the other students. We have about 16,000 students graduating from U.S. universities between 1990 and 2008 about 15 percent of which are Chinese and for comparison we also included the fellows for the National Science Foundation Graduate Research Fellowship Program so that this is a very prestigious award for a U.S. citizen or permanent resident who wishes to pursue doctoral training in U.S. universities.

These are the results and I apologize for the technical table which is coming from the paper itself. We are looking at productivity during the thesis and we seeing what compares among three groups of students, the Chinese students, the NSF doctoral fellows and all the other students. What we found in that table was -- speaking roughly can be interpreted as percentage differences so that the Chinese students are about 25 percent to 40 percent more productive than the other students. What we do is in column one we put all the students together, but in column two we compare students when enrolled in the same program and in column three we compare students who are in the same lab or who have the same adviser. The results are really quite robust. You may wonder is 20 to 25 more papers -- for quality during the thesis is that big or small, and that's why we have the numbers for NSF fellows. You can see that the type of productivity differential between the Chinese students and the other students is about at

the same order of magnitude as that between the NSF fellows and the other students. In other words, the Chinese students do almost as well as NSF doctoral fellows at least to the extent that they are enrolled in the same program and working with the same advisers.

I guess the interesting part is why is it that the Chinese students do well - - stories are following. In China there is a large demand for graduate education but to a large extent cannot be met by Chinese universities at least until recently. With the demand for a quality graduate education, students then apply to U.S. Ph.D. programs. However, U.S. admission committees lack familiarity with the Chinese system -- and so forth so that it's relatively more difficult for a Chinese student to get enrolled in a U.S. Ph.D. program than it is for an American student -- that's the case. But the other part of the story is that if you're in China and you want to do a Ph.D. degree in the U.S., you need to have an undergraduate degree from one of the really most prestigious schools to get into U.S. Ph.D. programs. This is going to be your passport that you are in and these very best universities in China are extraordinarily selective. The two best universities in China are Peking University and Tsinghua University. We can discuss this, but my calculations based upon admissions scores and so forth is about 40 times more difficult to get into Peking University than it is to get into MIT for instance.

What we show is that Chinese immigrants perform very well in graduate studies in the United States. We're saying that the graduate student is the workforce of the modern laboratory, and we are also saying that the professor is only as good as his best student because it's the student who is running the experiments and doing all the work in the lab and so the access to high-quality talented students enables universities to produce more science. However, there are a number of limitations to defining in that we don't know what happens after their Ph.D. We know that Chinese students stay in the

U.S., but we don't know whether they continue to outperform other students. On the one hand we know that initial productivity differences tend to continue over the life cycle of scientists and engineers. On the other hand, it could be that Chinese students may lack some of the skills which may be important in postgraduate occupations so that that's one limitation.

One point I need to emphasize is that it does not necessarily follow from the fact whether Chinese students or -- have a strong publication performance and it does not follow from that fact that immigration of these students is good thing for America and there are a number of possible counterarguments. The main one is that Chinese and other immigrations may reduce incentives for Americans to engage in scientific careers, for instance by reducing wages for postdocs. One thought at this point is there are tools besides immigration policy that could be used to address that concern; in particular the amount of NSF graduate fellowships could be increased to make scientific careers more attractive for talented Americans without toying with immigration policy.

Since I think I have three more minutes let me talk very briefly about my paper on return immigration. Generally speaking we don't know much about mobility choices of foreign scientists and engineers in the U.S. We can know to a certain extent if they stop answering surveys, but we don't really know what happens to them. We don't know if they've just stopped answering the surveys or if they go back to their home country or if they go to a third country. This paper looked at around 2,000 foreign faculty affiliated with U.S. Ph.D.-granting chemistry and chemical engineering departments. I'm observing or should I say reconstructing the career histories over 17 years and I have -- underlying population -- I'm following the careers of 2,000 faculty and I look at whether they go back to their countries.

The results are quite striking in the sense that only about 9 percent of

foreign faculty ever return permanently to their home countries so that close to 90 percent stay in the U.S. Moreover, there is virtually no return to India and China contrary to what you may read in newspapers. It seems like among those who return there is a kind of negative selection so I think in the sense that professors who are in good schools are less likely to return to their home countries. I guess the main takeaway here is that despite some recent concerns, the United States remains a very attractive place to do science.

MR. WALDROP: Thank you. Lindsay?

MR. LOWELL: Good morning. I'd like to thank David for inviting me today, Darrell and Brookings for hosting this session today and you for having an interest in the topic. What I'd like to do today is present some ways of thinking about immigration, skilled immigration and policy responses.

It seems that a lot of our thinking about immigration generally but certainly about skilled immigration as well is between as I'd characterize it as these polar opposites of we need more, they generate unusual and unique productivity in jobs, or we need fewer because they compete and they reduce opportunities for domestic students. I think by the end of this you'll see that I come out with somewhat of a third way of thinking about things.

I want to build a little bit on what you've been hearing here as well. Immigration policy crudely speaking has two important things that it accomplishes. One is to set the numbers of migrants that we admit, and the other is to control the quality. Are we really getting the best and the brightest? The numbers things is fairly easy to understand, the pressures that set demand for more or preferably a desire for a lower supply, but the other thing that is happening is globalization and globalization and really skyrocketing education rates in many source countries is changing the nature of both the

student marketplace and the possibilities we have for admitting the best and the brightest and I want to discuss that a little bit.

We heard the word “selectivity” here a little bit earlier. That is a kind of social science concept many of you are familiar with. Selectivity is how you actually get the best and the brightest. What forces and incentives create a demand for the best and the brightest migrants to come to the United States?

I have 12 minutes so I’m going to skip some of this. I have too many overheads. Since the overheads are too busy, I welcome you to listen to what I’m saying and I’ll skip them a little bit.

What I want to do here is set up in this slide what I’m going to be discussing briefly in the next three slides which is do we have evidence of past shortages in STEM, science and engineering? What evidence do we have of numerical restrictions when we look at labor market kinds of outcomes? And what will the future bring? Do we in fact admit too few? If you look at this slide and some of you have seen this, the reason that you see the bulk of a lot of Ph.D. students from abroad in the U.S. population at younger ages is because in fact we admitted a raft, a lot of skilled migrants in various kind of STEM fields as well during the latter 1990s and that was set in place by the 1990 Act during the dot-com boom which really changed the nature of demand and supply at both the policy and the labor market levels. In fact, if you look at this, arguably we certainly admit a lot of doctoral students, but even masters in the past and it shows up in the data.

This is foreign students. What you see there is a big dip after 2001, but you also see a big dip after 1981. What’s going on? The global economy affects the student supply inflows into the United States, and I think arguably the 9-11 effect was pretty minimal and I have some data that suggests that that was the case. The numbers

have again started to respond to the global economy so that the inflow of students from India is down 20 percent similar to what it was after 9-11. It's the economy. What's unique about what's going on right now is that there has been a 40 percent increase in Chinese students in the last couple of years so that Chinese students are coming to the United States in record numbers and they're such a large group that they're offsetting what would otherwise be a pretty much across-the-board decline in student enrollment in the United States. Think about this too in terms of globalization and in terms of market share. We know that the U.S. market share of international students fell from about 25 to 20 percent over the last decade. People say that's terrible. Yet at the same time the number of students in the United States increased by 100,000 or about 20 percent. That's a phenomenal rate of increase. If as is the case we're seeing a nonlinear growth of foreign students in source countries, for us to regain a third of international student marketplace like we did 15 years would be nonlinear growth of foreign students in U.S. institutions. Can we absorb that many students? How would it change the nature of education?

What does it mean to have shortages in STEM? If you look at this box down here, and you can't like I warned you read all this stuff in any great detail, wage change in IT and even natural sciences lagged other professions. The person who looks at this, Mr. Lemieu says it's difficult to understand an industry with a high level of demand generates so few wage gains, so where is the evidence of shortages? Then I play another game. I took a projection; this is a few years old, of BLS. This is the total number of computer scientists and engineers that BLS sees us having at 2017. That's the number employed. I then look at domestic rates of enrollment and extrapolate them out into the future and this is what we produce on the domestic side. The residual then is what we would apply with foreign-students and foreign-student skilled migrants and we

would see an increase from 18 to 24 percent of their share of that particular occupational sector.

Here are two things I want you to keep in mind one of which is that's an increasing share by almost a third in terms of the foreign born in these occupations, and here is the other thing that's interesting. At our current level of immigration, the numbers that we admit annually, we'll hit that. We are admitting enough foreign students and foreign skilled workers to meet that fairly sizable gain in foreign share of the projected labor market.

Now let's talk about globalization and the this issue of selectivity a little bit and I want to talk about a couple of different examples, so that we're moving from numbers now to this issue of quality. While Nobel Laureates are the cream of the crop, they are also a small number so that people when they see this they dismiss the example because it's a small number and I agree, but they're systematic of a phenomena that I'm talking. The theory by Hunter, *et al.*, is that when you have big barriers to migration as in the Chinese example, what you do is you create an environment in which you really are highly selective of those who move who can bear the costs and have the special qualities that make the move across international boundaries pay off. We know for example that the immigrant share of Nobel Prize winners has declined. That's the globalization thesis right there. Globalization shrinks labor markets, lowers the cost of mobility and therefore is less selective and you certainly see it here. But you see it in another remarkable way too. That is, immigrant share of the Ph.D. labor market in STEM has increased markedly while at the same time the share of Nobel Prize winners has decreased so that there is a decreasing selectivity in at least two ways that you can see there.

Are there other ways in which you can see this? This is an ugly graph I realize. It was better when I did it last night. What we have here is three different fields.

The point is that this is the ratio of educated with bachelor's or above because this is what the data permits me to do, educated in life and physical natural sciences. They are about 35 percent more likely to have a college education than natives. That's out here back in 1950, but their ratio of educational advantage has been doing down. The same thing with engineering with a little blip. The information technology is quite different and that's fascinating, but remember that information technology is a bit of an odd bird because a little bit under 10 percent of IT workers don't even have a high school degree among the domestic labor force, so what does it mean to be more educated in that context? Earnings ratios have gone down again except for IT which is strange. Over time what this is what we call in social sciences "de-selectivity," where globalization shrinks labor markets, decreases the selectivity of international migrants and you see it in terms of their relative education to the domestic labor force and in terms of their relative earnings.

You're going to hear from I think Dr. Hunt and others and I think you've also heard here earlier there's a lot of good evidence that foreign both workers and students are highly productive. Are they uniquely productive is the question. One thing you also hear about and we may hear about it a little from David is the rate of startups. Depending on the data you get, you can get somewhat different stories about the relative productivity of immigrants. But what I want to look at very quickly is this idea of corporate leadership using just national-level data or simple data.

What we can see is that at the level in the United States about 12 percent of STEM workers in the communications and technology industries are self-employed and a large share and a fairly remarkable share are also CEO business owners. In Silicon Valley which you probably can't see too well unless you look through Patrick's head here is quite a bit higher and fairly remarkable in Silicon Valley in terms of

directorship of corporations yet their share of their labor force is higher.

Where am I going? I want to return to the themes of numbers and quality. Numbers you can set in different ways and quality is also set by the marketplace, but it's also uniquely set by policy and there are three different kinds of philosophies I think generally. One and three are the ones I opened the presentation with. One is you set large numbers and the market will self-regulate and make the policy process painless not simply to facilitate skilled migration or student migration, but to make it pretty painless. Talk to anybody in a business HR department and hiring people is not painless. It's not clear that admitting migrants need be less painful than just doing good hiring.

The 2006 bill that I mentioned here, Senate 26111 would have increased skilled migration by over fivefold with escalators for H1Bs but it would have set the system pretty much the same. Numbers increased in that way I argue will have an adverse effect on quality selection. On the bottom end, there is an argument that we have an oversupply of highly skilled workers. The third way which is number two is what I suggest people also consider which is balancing numbers and quality. Thank you.

MR. WALDROP: Thank you, Lindsay. Finally, we have Darrell.

MR. WEST: Thank you, Mitch. What I'd like to do is focus on the policy aspects of immigration specifically as it relates to higher education building in part on the very interesting papers and empirical analysis that has been presented here, but I want to start with some brief remarks on my immigration book, *Brain Gain: Rethinking U.S. Immigration Policy*, because what I do in that book is argue that we need immigration reform in order to boost long-term economic development and productivity. I put a picture of Albert Einstein on the cover of the book to remind all of us about the many contributions immigrants have made to American life over the years.

We all know that Intel was funded by a Hungarian immigrant, Google

was co-founded by a Russian émigré, Yahoo! was established by someone born in Taiwan, and eBay was started by someone from France. What would the American economy look like today if Intel was a Hungarian company, Google was based in Russia, Yahoo! was a Taiwanese company and eBay was French? I argue that these are not isolated stories. Studies have found that many Silicon Valley companies had a foreign-born founder or co-founder. Immigrants have made vital contributions to our economy. Just this morning we've heard very interesting examples of the role of international students in terms of productivity, we've seen in Robert's paper the rising number of foreign students over the last 20 years and Patrick documented the higher productivity. Lindsay has some very interesting nuances to the story in terms of worker shortages broken down by field and we see some of the interesting contrasts between the IT field versus some of the other areas. Then later on the second panel you'll hear more from David about the role of immigrant students in establish startups. I think that in a lot of respects there is evidence about the contributions that immigrants make, but yet when you look at our politics, our politicians are paralyzed by this subject.

It's ironic that it's been difficult for our political leaders to address immigration even though virtually everybody dislikes some aspect of the status quo. I think the problem with the immigration area is that people perceive costs as being high while benefits are low. In that situation there is no big surprise that the policy becomes radioactive for politicians, it becomes hard to resolve, there is a lot of emotion and there are many myths and false information surrounding that discussion. One of the reasons why we wanted to put on this forum today was to inject some facts into a very emotional and polarizing topic. It's not like everybody is in agreement on what the facts are, but I think it is both interesting and important that there be some factual bases to these discussions so that we're not just making decisions based on opinions, ideology or false

beliefs.

In my book I make a number of policy recommendations about various aspects, but I want to focus specifically on the international student aspect because that's what this panel is really focused on. I found it very interesting in Robert's paper that he found that 38 percent of doctoral students today are coming from abroad, but yet very few of these people actually have an opportunity to stay here. One of the suggestions I make in my book and others have made the same suggestion, for example Mayor Michael Bloomberg has talked about this as well, is automatic green cards for foreign graduates of American science and technology Ph.D. programs. We're not talking about a large number, because if you look at Robert's paper it's not a huge number that is required, but in terms of the quality, the possibilities for innovation and the opportunities for entrepreneurship, I would argue that the economic benefits are huge. Certainly when you look at the information technology field, the dot-com field and the number of high-tech companies that have been started by immigrants or foreign students who came to the United States to enter Ph.D. programs, there certainly are a number of examples where these individuals have made a dramatic improvement.

We could trust the market and there certainly are some policy mechanisms that are in place to match up the supply and demand in terms of the need we have for science, technology, engineering and math students, but we need to keep in mind that the job opportunities are starting to change. It used to be that we just needed math students for higher education to train future mathematicians and so on, but in recent years we have seen the world of finance to start to hire mathematicians. They're starting to take some of the people who used to go into higher education and become college professors, the hedge fund companies, the private equity firms, the risk assessment individuals, are not starting to drain off some of these individuals. I would be very

interested in seeing Lindsay's paper projecting into the future that when you start to see greater demand across a variety of different areas not just traditionally science and technology areas for people a Ph.D. in this area, is that mismatch going to become larger? Is it going to become a national crisis? For that reason I think we need to become more proactive as a nation, we do need to think about some of the policy actions designed to fill fields where there are likely to be shortages and if you take the results of David's paper seriously, if we think about the entrepreneurship aspects and the startup aspects, these are the people who are going to come, they're going to innovate, they're going to create jobs, they're going to build businesses and they're going to be major parts of the U.S. economy so that I think we need to get more strategic in thinking about our need for high-skilled workers and the role that international students play in that area. Thank you.

MR. WALDROP: Thank you all. Have I forgotten anybody? I don't think so. We have kept to our time admirably. In fact, we're ahead of time so that we'll have lots of opportunity for Q&A.

I'd like to start if I might use the moderator's prerogative, we've of course been hearing about immigrants and the contribution they make, but we also regularly hear anguished reports about the poor state of STEM education in the United States, actually every country seems to moan about that and the implicit implication there is always without usually being discussed, it's just an assumption, that we need more people in these fields, yet Lindsay you were talking about maybe there isn't a supply problem, we seem to have enough and we seem to have foreign students clamoring to come in. This is a vague question, but how do you balance this immigration issue, this immigration policy debate, with these calls for improving our domestic supply of scientists and engineers?

MR. LOWELL: This is not an easy nut to crack. On the domestic side, work I've done with Hal Salzman, a colleague at Rutgers, certainly suggests that some of the simplistic ways in which we think there is a lack of supply in the pipeline don't measure up. About a third of incoming freshmen over the last three decades have said I want to study in STEM fields so that there is no drop in interest. In terms of those who are capable, high school math scores within the United States are actually up. If you look at international tests, we don't often do that well, but then remember there are maybe 5, 6 or 7 million STEM workers out of a labor force of over 150 million so that everything has a distribution. How many highly skilled people or how many in the top percent of the SAT scores do you need to supply that labor market?

Darrell brings up a more interesting issue I think. At its extreme it gets into an issue of science citizenry and this is an old thing, it's been around for a century or more, the idea that to really be an adequate member of a modern society you'd better understand science. At the extreme it's hard to know how to deal with that. I think it's true, but how much science do you need to know? If you look at the financial industry, there is large share of STEM workers in STEM occupations there, but a small sector overall so that it's not siphoning everybody off. Or another way to look at it might be there are maybe 15 million people in the United States with a STEM education and maybe a third of that in STEM jobs, so certainly some of them are working outside of STEM and that's probably a good thing, but how many more do you need and that's a hard nut to crack.

MR. HAMILTON: Just one comment. I believe Salzman also points out that when compared to foreign students, U.S. citizens tend to leave the pipeline earlier. The sense is that talented Americans don't stick around to get their doctoral degrees, there's a greater tendency to enter the workforce so at a certain point when you compare

foreign doctoral students with U.S. citizen doctoral students, you have two different populations. I don't want to misquote or misrepresent his views, but he seems to suggest that the best and the brightest of the Americans tend to leave the pipeline earlier whereas the most talented of the foreign students tend to stick around and get their doctorates.

MR. WALDROP: That's not right?

MR. HAMILTON: Please correct me.

MR. LINDSAY: Hal and I did some work with several longitudinal data sets and looked at progression through the pipeline from high school into college and into the labor force from the 1970s through the 1990s and early part of the last decade. What we found is that the change or the rate of attrition at each level in the pipeline, high school into college, bachelor's, master's, the Ph.D. labor market, a few years out the labor market, 5 to 6 years out, the transition rates hadn't changed much overall except for interestingly, and we didn't break it out by nativity, in the 1990s there seems to be a dip in retention in STEM jobs and STEM higher degrees among the top quintile performers. That's an odd outcome and we don't really know what's going on so that something did happen in the 1990s among the top performers.

MR. WALDROP: I believe there are microphones coming around.

MS. ORCHOWSKY: I'm Peggy Orchowsky and I'm the congressional correspondent for the *Hispanic Outlook on Higher Education*. I write a lot about immigration and have written a book on immigration and the American dream. Being a journalist I have questions for each of you so please bear with me.

Patrick, I wonder if you have studied about cluster in various universities, that foreign students in certain geographic areas even certain parts of India would tend to cluster in one university around say a scholar from that university. Lindsay, I wanted to ask you more about the wages tending to reduce as the foreign-student population and I

haven't heard that 90 percent before. I've usually said 70 percent stayed, so the 90 percent is really huge.

Darrell, I wanted to ask you about the numbers. You said there are few, but you were saying that the foreign-student numbers hit the peak of 600,000 and hit over that peak a couple of years ago and now it's close to 700,000. The majority of those students on foreign-student visas of the 700,000, the majority are graduate students, the majority of those are in STEM so that we're probably talking 250,000 people. If they're given automatic Green Cards I would think that is a significant number. Could you talk about the number and they're not all Nobel Laureates and they're not all going to start a Google so we're talking about the quality of 250,000 plus and if it's retroactive we're talking maybe a million people?

As to politics, of course in the whole politics of immigration where I cover a lot is on low-skilled workers. I think Darrell you and I were talking at one point that this is a zero-sum gain if we're giving green cards to foreign students maybe at the expense of extended family visas and I think there is a lot in the Hispanic caucus particularly who are against that.

MR. WALDROP: Patrick?

MR. GAULE: We definitely observed clustering of let's say Chinese students in certain universities and in certain labs so that at NYU more than 50 percent of Ph.D. graduates from the chemistry department are Chinese, at Berkeley it's -- percent. If you look at labs that are headed by a Chinese professor have about 40 percent Chinese students which is much higher than the population. And you have the intriguing fact that you have labs which are doing extremely well, for instance at Stanford -- technology where you have one famous Chinese professor and his lab is almost entirely Chinese so that it's an interesting phenomenon but it's not exactly clear what we take

from that.

MR. WALDROP: Lindsay?

MR. LOWELL: Again, STEM immigrants in general are better educated than natives so that their nominal earnings tend to be higher. The point I was trying to make is that if you use relative wages as another way of looking at selectivity, that earnings premium has decreased over the last half a century and there are different ways you might want to think about this. That was a simple point. That was a new set of slides I produced. I always like to do something new in my presentations. I was also doing some simple regressions on wage differentials *ceteris paribus* and it turns out that with *ceteris paribus* of course immigrants don't have differential earnings in STEM fields than natives. Jennifer Hunt is not here. That has a heavy caveat as to again class of admission so that it gets back to policy. Policy is a screening mechanism and the class of admission makes a big difference in earnings outcomes for migrants so that policy matters. I think I'm going to skip the stay rate question.

MR. WEST: Peggy had a couple of interesting questions in terms of the numbers and if we gave every foreign student who got a Ph.D. in a STEM field an automatic green card would that overrun the system? I guess I would argue that when you break down the number of foreign students who are here today, you're taking out the undergraduates, you're taking out the graduate students in non-STEM fields and then you're taking about the people who drop out along the way so that I think the numbers do start to drop. But then the question is let's say the number is still a big number. We don't have the best device for picking who is going to be the Sergey Brin, who's going to end up starting Google or an equivalent type of company, so that you need to admit numbers sufficient to raise the probability of being able to find those people and keep them here so that the spirit of that proposal is designed to expand the field beyond what we have today

because today we're at the opposite end of the spectrum where there are so few foreign students who really have an opportunity to stay here unless they have already found a job and are able to qualify for a view through their employer.

Then on the zero-sum game between low- and high-skilled workers, it becomes a zero-sum game only if we stick with the current number in terms of the visas either permanent or temporary visas that we provide. In that situation then there is tension between the high-skilled and the low-skilled areas, but if we ever reach the point where we increase those numbers it becomes much less of a zero-sum game.

MR. WALDROP: Lindsay, did you have a reply?

MR. LOWELL: I want to again throw some of these policy issues out there because they're tricky. There is something called the Staple Act, that you staple a green card into a foreign graduate's degree and they get to stay in the United States. I have the following issue with that. If you look at the Australian experience where they essentially gave landed status to graduates, it created a decade of problems for them because it created the wrong incentive structure. What happens is, and I hope this doesn't surprise you; the students came to Australia to get landed status and not to study. So the incentive structure that you build is very important and greater numbers will not necessarily yield you greater results. You have to design the incentive structure right. Francis is here I notice. I think lengthening the OPT for STEM workers is the right way to go in terms of setting an incentive structure for research and study which is what we want our students to do.

MR. WALDROP: Please one question per person.

MR. NORTH: My name is David North. I'm with a small think tank called the Center for Immigration Studies down the street from us. My question to this all male panel is why hasn't anybody mentioned the tension between essentially male overseas

Ph.D. students and residents of this country who are female? I also would not in passing and I think this is correct that in the area where the percentage of foreign-born PhDs. is smallest which is the life sciences I think is also the area in which there are more women percentage-wise than in the other four fields and I wondered if one of you might speak to the gender issue. Thank you.

MR. HAMILTON: Thank you, sir, for asking that question. Connie McNeely, George Mason and I are beginning a study on the gender issue and I think it is fascinating. What we'd like to do is to take a look at the demographics as in the presentation I gave and break it down by gender and to see if there is any association to do the richer nations tend to have larger or smaller representations in the male of female populations. But the question that I asked is is there a large untapped population or talented women out there who are not being recruited to U.S. universities? Give me about a year and I'll get back to you on that.

MR. BRODSKY: Mark Brodsky, retired physicist. I want to ask a little bit about your data about the entrepreneurship. You have these examples of Intel and Google. There are two types of immigrants involved in that, one who comes here to study and one who came here for political reasons either with a visa not necessarily to study but for political asylum and both of those examples, Intel and Google, are the latter I think.

SPEAKER: I think you have to look at your data to separate that aspect from the --

MR. WALDROP: Would anybody like to comment on that? In that case, back there.

MS. MILLER: I'm Agnes Jennifer Miller and I'm a doctoral candidate at UNC Chapel Hill and this question is for David Hart. You had mentioned the intriguing

counterfactual of what if Intel were a Hungarian company and Google were a Russian company, but do we know that that is the alternative outcome? Are perhaps these entrepreneurial success stories due to some of our other institutions around entrepreneurship in the U.S. and might that counterfactual be that we would have waited a few more years before those companies were founded and then they would have been U.S. companies by the next person who grasped a similar idea.

MR. WEST: That's a good question. Counterfactuals are always hard to test by definition, but I think it is apparent that the United States is facing growing competition for entrepreneurship especially in the IT area. The new president of Russia has talked a lot about trying to create a Russian Silicon Valley so that they are very much devoted to training their students and keeping them in Russia and building the companies there and we see the same phenomena in a number of different Asian countries. So I guess the worry I would have is when you look to the future with so many other countries seeing the power of information technology as well as life sciences, the link between those areas and economic prosperity and job creation, they are now trying to keep those students home so that they can get the benefits of those contributions. That would be the thing that I would worry about as we move to the future.

MS. LIPCHUK: My name is Loren Lipchuk. I'm working on my master's in public policy at Mason and I'm also an immigration paralegal so that it is kind of a great intersection of those two interests. I'm curious if you think that particularly for Indian and Chinese nationals if there is any added incentive because of the visa regression in the EB2 category to stay in the pipeline through Ph.D. and to be extra productive with their scholarly work to try to attain the EB1 category.

MR. GAULE: I think you are exactly right that that could be part of the story, but it's a bit difficult to distinguish this from the fact that the type of students who

come into the United States are not different from that in some other respect.

MR. LINDSAY: I'd only add that the EB1 is typically for older and more productive scientists so I'm not sure that it applies to the student model too readily.

MR. MEHAM: Josh Meham with the Global Innovation Forum. I have a question regarding a very small snippet from Mr. Gaule's presentation where you talked about that there was some data that indicated that a higher presence of immigrants being interested in science and engineering, possibly that there were fewer Americans who were actually interested in pursuing it to that level. This is for anybody who wants to answer this. What is the best incentive that people seem to respond to? Is it the wonder of science? Is that why people come here and continue to get their PhDs. and stick around? Is it for cash? Because someone said that a decrease in wages could be a reason why Americans are less interested and of course finance is draining lots of our mathematicians. So what is it that we need to instill to actually get people here again interested in science and to pursue it to the kind of extent that it is important? Thanks.

MR. LINDSAY: If you look at surveys of immigrants, they'll tell you the reason they come to study in the United States is the quality of the institutions but also the love of science. If you like a good social economist look at the data, what we find is that economic incentives really matter to the flow of migrants across different countries.

There was a really fascinating piece recently that looked at the availability of H1B slots and its impact on SAT performance among foreign students and it has a positive impact. The story there is that there's a labor market motive as well. Creating the right incentive structure is a difficult thing to do. One of the things that's clear in a Sputnik moment is you can't simply gin up the supply side. You have to have a demand side as well. If you don't stimulate the demand side you don't get the wage growth and if you don't get the wage growth you don't attract the domestic labor force

and you probably in the long run don't have a favorable on immigrant quality either.

SPEAKER: I'm (inaudible), an intern for Immigration Equality. I have a question about some of you mentioned the statistics of how many people are getting Ph.D. degrees and how many people are going back to their countries. Would you say that that's related to personal reasons like family and if so if we create a system where they can stay in the States with their families, how much of an impact would that have to the American economy?

MR. WEST: That's a very important question. If we did do the automatic green cards for Ph.D. graduates in the science and technology fields, how many would want to take advantage of that as opposed to going home? I think in the past more would have availed themselves of the opportunity to stay here because of the opportunities, but I think moving forward this is where the United States is facing more competition that those home countries are now making a major effort to bring those students back and the economic opportunities that are going to be available to those students especially those coming from Asian countries is going to be huge. We all have seen the estimates that by 2050 China is going to have a larger economy than the United States so that I think when that individual student is making that decision do they stay in the United States or do they go home, obviously there are a lot of factors that go into it in terms of family reasons, the situation in the home country as well as their perceptions about economic opportunity.

MS. SINGER: Audrey Singer from Brookings. I have a question about demand and supply and how to measure these things when we're talking about high-skilled workers overall. How do we understand the demand for workers, how do we measure it and what do we know about the international selection of workers into those streams? It's a bigger question about our economy that we're going through a

restructuring right now, what do we know from the past, how do we understand demand at this point? I'm looking at Lindsay.

MR. LOWELL: We don't, but we do look at certain kinds of indicators. We look at levels of unemployment which in STEM tends to be low. We look at wage change which has been low and if demand for lawyers can increase wages 30 to 40 percent over a long period of time, why is it not changing STEM earnings at all? In fact, why do STEM earnings tend to lag other professions? Do we need that many lawyers? I like lawyers, don't get me wrong, but how many do you need? What's the relative demand? We don't know. But we do know one thing fairly clearly in research which is that supply will respond to wages so that if employers put their money where their mouths are, they will stimulate a supply. In a simple way I think that's one way you can look at it.

The more complex answer is we're looking at wise commissions to do this stuff, the Migration Advisory Committee in the U.K. is an interesting example, using multiple ways of trying to determine demand and the standard critique I get to my kind of presentation is how about petroleum engineering? That's a booming field. Yes, it is. So it doesn't really match up with what I'm talking about engineering generally. To get at that fine level of detail which is what employers care about, which is what the economy cares about, which is what Darrell cares about when he's talking about certain kinds of mathematical aptitudes bleeding out into non-STEM occupations, it takes a really finely disciplined kind of approach. My approach is probably not to try to over-fine-tune things but set the appropriate incentive structures and let the market work it out.

MS. TURNOW: Hello. I'm Yemena Turnow with (inaudible) Foundation and I'm starting a project on human migration. My question is for everybody on the panel. What aspect of this topic that we are talking about today do you think would be the most useful for the U.S. public to discuss? Thank you.

MR. WALDROP: Darrell?

MR. WEST: That's a very good question and obviously it's so good that we're having difficulty answering it. I guess I would answer it by saying the problem I have with public discussion in the immigration area in general is how emotional it is and not linked to facts. I often like to contrast our discussions about immigration with our discussions about Social Security. Social Security also is seen as a radioactive issue. It's often described as the third rail. Politicians can't really address it. But the difference in the Social Security area is there tends to be an agreement on basic facts and then people argue like cats and dogs over the interpretation of the facts, what the policy ramifications are, how we should address things and so on. The problem in the immigration area is not only are we arguing over things, we're arguing over the basic facts. So what we tried to do this morning was try and provide some empirical evidence to address these things so that what I think the public needs to understand is what the facts are of the situation and it's not like there is always going to be a complete consensus on those facts but I think that's what distinguishes the immigration area from a lot of other areas and the reason why it's been so difficult for our country to address.

SPEAKER: For the general public I think it's useful to say that there are a lot of talented people in the world and if the United States or any other nation has use for those folks then what's the problem? If you study some type of migratory movement, a student might get his doctoral degree from the United States from China or India and they have contacts in China and India and some of the research shows that their contacts both in the U.S. and China or U.S. and Taiwan is a win-win situation. For example, a Taiwanese company might be started by a Taiwanese doctorate out of Silicon Valley, jobs are created in the San Francisco Bay area, maybe jobs are created in Taiwan and maybe there is offshore somewhere else, Mexico or wherever.

I think the story that should be told is this is not a zero-sum game. There is great potential for win-win when you educate people, when talented people are able to go where there are jobs then good things may happen and I think the challenge for the researchers is to quantify that and make the case and I'm saying that, but the challenge is to give evidence to show how this does create jobs and makes lives better for both the United States and other nations.

MR. LOWELL: I hesitate to say this because it's not normal for somebody in education. I'm not sure that the public needs to know more. I often used to think that was the case. I often used to think that was the case, but consider this. The GMF just did an international survey and they asked people in the United States what proportion of the United States population is foreign born and they said about a third and that's double the actual percentage. Then they asked what proportion of the foreign born are undocumented illegal residents and they said about half. I said they really don't know what they're talking about. Then the commentator at the National Press Club made a very interesting point. He said they may not be knowledgeable but maybe they're wise. For example, about a third of the U.S. population is foreign born and their children, so what do you mean by immigrant? And at least half of those who arrived in the last decade are unauthorized and the number of unauthorized migrants on a yearly basis exceeded legal migration for a good part of the last decade. How much more do we need to educate and in what way?

I think from my presentation what I'd like the public to understand is that there is a tradeoff between numbers and quality and setting incentive structures is a very difficult thing. Possibly and there may be a few here who agree with me, Congress should be less involved in doing these things and we should have more of a model like Canada or Australia where you have responsive, dynamic bureaucratic control of these

things with congressional oversight so that you get the incentive structures correct.

MR. SANG: James Sang. We have a system that mixes H1B and EB. Would any of the panelists like to talk about how these should fit together and in fact where there is an optimal mix of the two?

MR. WALDROP: Would anyone like to try that one?

MR. LOWELL: I think we need a lot of creative thinking -- has recommended a provisional visa which would do away with the system we have so that if one gets a provisional visa you automatically progress to permanent status. There are a lot of smarts to that. If we were to stay with the current system, clearly the H1B numbers exceed the funnel at the other end into the EB and even if you do away with the per-country caps you're not going to get around that problem. The numbers just don't wash. So if you're going to stay with the current system I would say that the H1B either needs to be smaller or probably smaller and I would say more temporary, a 3-year max, so you could change it dramatically to make it a true temporary and I think if you did that and maybe expanded the EB which would be a very good idea, I think we'd be in a much better situation.

MR. NOTCH: Saul Notch, George Mason University. The panel seems to imply that there is a U.S. problem; we need immigrants to grow our country, to innovate and to be successful. I really wonder if that's true, because what you're implying is that there is something really wrong that we want fixed and we want to fix it with immigration. I'm not sure if the panel actually believes that. Or is immigration really some other bigger issue about American exceptionalism that we don't understand? But with this economic issue I'm not sure that there's something really wrong that we need to fix with immigration.

MR. WEST: I guess I would answer that by focusing on innovation and

certainly the President in his State of the Union address talked about the importance of innovation for long-term prosperity and job creation so that I'm interested in the immigration angle because of the tie between immigration and innovation. I think there are links between the two at various levels that we've talked about in terms of startups, contributions to knowledge and so on so that I think that's the crucial link.

The United States has done very well on innovation in the past. I think the worry that I have in going forward are we going to do as well, and if we don't do as well what is that going to mean for our economy over the next 10, 20 and 30 years.

MR. JACOBSON: I'm Ken Jacobson, a recently released Democratic congressional staffer. In talking about the incentive structure, I wonder if one of the problems isn't the market trend to send both productive capacity and high-skilled jobs to other countries in recent decades and may be compounded now by what we've seen in the last couple of years with a marked lack of investment particularly at home where companies are sitting on a lot of cash. I wonder what message that sends to people here about whether their skills are going to be applicable here with places like GE and Intel doing so much research abroad. The foreign students are already from somewhere else and they come here so presumably there are willing to go somewhere else or they're willing to do home. Americans tend to believe that we're the number-one country on earth so why would they want to go some place else? Also when it comes to innovation, it seems that for a number of years at least from what I've heard about in Silicon Valley, if you have a startup plan and part of the work is not being done in Asia you can't even get in to talk to somebody.

My question is in the absence of a clear future regarding either productive capacity in the United States or commitment to corporate research in the United States, are we going to have a great deal of success attracting young people who

are American citizens into scientific careers?

MR. WELL: All I can say is before I came to Brookings 2 years ago I taught at Brown University and when you go into the Ph.D. programs in many of the math, engineering and science fields, the clear majority in some departments, it's up to two-thirds or three-quarters, are foreign students. That's the crisis that some people are perceiving about STEM education in the United States, that American students are no longer going into those fields. Then if you combine that with lack of opportunity for foreign students to get the degrees and then to stay here, that becomes a crisis. We can solve that problem in several different ways, but if American students are not studying the STEM fields and we're not providing very many opportunities for the foreign students who are interested in STEM areas to stay here, that has the makings of a crisis.

MR. LOWELL: One thing Darrell and I certainly do agree on is that the number of foreign graduates coming out of our institutions isn't so large that it's going to tip things usually one way or the other. It's an important resource and most of us do believe we benefit from migrants and at the last we know that the system is running in mud so that it should be fixed in some way so we don't have these bottlenecks that we have at so many different levels. I guess if you have to really simplify it for Audrey's question, can you resolve these innovation issues about what Badwati calls the American fear of being a diminished giant, can you address these innovation demands and these fears by simply ginning up the supply side? I think arguably no, that you have to have heavy investments in R&D. What triggered the Sputnik moment was investments in the military. Would we go that way now? In other words, I think you have to work on the demand side as well as the supply, we can over-focus on the student issue altogether, and the domestic pipeline I think will respond if the appropriate incentives are there.

MR. WALDROP: I wish we had more time. This has obviously been a

very lively and productive discussion. I want to thank you all and invite you back for the next session.

(Recess)

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