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Reinvigorating small businesses

Identifying obstacles and finding solutions to drive growth and job creation

The Goldman Sachs Group, Inc.

The Global Markets Institute is the public-policy research unit of Goldman Sachs Global Investment Research, designed to help improve public understanding of capital markets and their role in driving economic growth.

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This publication is a compendium of reports previously issued by the Global Markets Institute, including "Who pays for bank regulation?" (June 2014), "The two-speed economy" (April 2015) and "Narrowing the jobs gap: overcoming impediments to investing in people" (July 2016).

The quality of the current U.S. economic recovery – now among the longest on record – has varied widely for small firms relative to large ones. Despite what the national economic data would suggest, new firm formation has been softer than in the past and small businesses have suffered tepid employment, revenue and wage growth relative to large firms.

The most widely-cited and most likely explanation for this bifurcation, which we discuss at length in "The two-speed economy," is that the cumulative impact of post-crisis regulations and related policy actions contributed to this outcome. For example, new banking regulations have made bank credit both more expensive and less available, which has affected consumers and small firms disproportionately since they largely lack alternative sources of financing. At the same time, large firms have been able to tap into the public capital markets at low rates (see "Who pays for bank regulation?").

The soft small business environment should be a cause for concern for policymakers and regulators alike. Small businesses support workforce dynamism, employing a more diverse group of individuals than do large firms; for example, small firms have a larger share of employees who are younger (less than 25 years old), have a formal education below the high-school level, and are older (65 years or older). Small firms also serve as a critical "safety net" for individuals shifting between jobs, or even careers.

These dynamics are exacerbated by ongoing technological disruption of the labor market. On the one hand, the activities that are offloaded to machines tend to be data-intensive, repetitive and standardized – work for which technology and machines are more efficient than people, especially when done at scale. On the other hand, people maintain a competitive advantage over machines in almost all contexts in which repetition and measurement are not central or even possible. Jobs that require people also frequently involve interpersonal interaction or have a social aspect, which tends to mean they can be done only on a small scale.

Small businesses, which often define their competitive advantage as their ability to offer personalized service and bespoke output, are important sources of employment amid the changing jobs landscape. They may be able to better leverage the specialized skills that larger firms no longer need, create new types of jobs that offer a safety net and also serve as a key source of training (see "Narrowing the jobs gap: overcoming impediments to investing in people"). However, given lower rates of new firm formation relative to the historical trend – there are roughly 675,000 "missing" small firms[1] – the safety net small firms can provide is no longer guaranteed.

[1]Using a simple trend line, we estimate that if the number of firms with fewer than 500 employees had grown in-line with the historical pattern seen from 1977 through 2007, there would have been roughly 675,000 more small businesses in 2015. This figure is an update to analysis from "The two-speed economy" report using data from the U.S. Census Bureau.

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Who pays for bank regulation?

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I. Who pays for bank regulation?

In the wake of the financial crisis, a wide range of new and revised rules, regulations and practices have been imposed on the US banking industry. These include measures to strengthen and raise capital, reduce leverage, improve balance sheet liquidity and bring greater standardization and transparency to derivatives markets. They also include new rules around credit card availability and debit-interchange fees, along with heightened regulatory and judicial scrutiny of bank lending and other practices.[1]

While many of these steps are designed to strengthen the safety and soundness of the banking system, they also act as a tax on banks: by changing relative prices, regulation makes some activities more expensive and others cheaper. Taxed activities become more expensive for banks to produce and for their customers to consume. As in many markets, higher costs typically reduce the amount of activity undertaken. Thus the bank tax affects the distribution of activities across different types of consumers and businesses in a way that allows clear winners and losers to emerge. This then leads to two questions: 'who ultimately bears the cost of bank regulation?' and 'what are the broader economic implications?'.

The multiplicity and complexity of post-crisis regulations complicate the process of answering these two key questions. Largely because multiple new rules affect the same activities, there is substantial uncertainty as to which rule is binding at any point in time. This makes it extremely challenging not only to assess which rule ultimately determines the cost to the end-user of bank services, but also to understand each rule's effect on the broader economy.

Economic assessments are made that much harder because the public discourse tends to be about macroeconomics, typically focusing on the impact to overall GDP or employment, or one of abstract financial theory. This macroeconomic focus leads to muddled results, because while it may be possible to estimate the initial economic impact of a new rule, there is almost always a policy response that can offset much of the aggregate effects that are visible in the macroeconomic data. The availability of these offsets transforms the public dialogue into a discussion of the ability of policy to offset the aggregate effects of regulation, rather than a discussion of the cost of each new rule itself or of who bears the cost.

A way to better understand the impact of new bank regulation is to focus on the microeconomic impact of the new rules *within* the economy, rather than *across* the economy as a whole. Looking at regulation from a microeconomic perspective shows that the cumulative impact of the new rules is more straightforward than the current public discourse might suggest.

In practice, the microeconomic cost of regulation is determined by two factors: the size of the regulatory burden and the degree to which less-regulated alternatives are accessible. As a result, consumers and businesses that have ready access to alternative sources of finance are less likely to pay the incremental tax that regulation imposes. Conversely, consumers and businesses without access to effective alternatives to bank lending are more likely to pay. This is particularly true in cases where the new rules single out certain activities as especially concerning and impose further taxes, whether in the form of higher capital charges, more stringent regulatory supervision or activity-specific legal and regulatory costs and restrictions.

While there is some added subtlety to the results of our analysis, we find in general that **low-income consumers and small businesses – which generally have fewer or less**

[1] See Appendix A for a list of new rules and regulations imposed since the crisis.

effective alternatives to bank credit – have paid the largest price for increased bank regulation. For example, for a near-minimum wage worker who has maintained some access to bank credit (and it is important to note that many have not in the wake of the financial crisis), the added annual interest expenses associated with a typical level of debt would be roughly equivalent to one week's wages. For small and mid-sized businesses the damage from increased bank regulation is even greater: their funding costs have increased 175 basis points (bp) more than those of their larger peers, when measured against the pre-crisis period. That funding cost differential is enough to seriously damage the ability of smaller firms to compete with their larger competitors. This fact has become all too evident in the economic statistics and is already changing the shape of American business, as small and mid-sized firms, the historic engines of US job creation, shrink and sometimes disappear, displaced by large corporations.

II. How to assess who pays for bank regulation

The key to assessing the impact of bank regulation within the economy is examining how its effects differ across markets. Two factors are at play. The first is the importance of bank intermediation in any particular market segment, which can be seen in the degree to which consumers and businesses can substitute away from banks for their financing needs. We term this 'banking intensity.' The second is the extent to which various bank activities have been affected by new capital charges, other regulations or heightened judicial and regulatory scrutiny.

Exhibit 1 shows the results of the analysis we have developed for measuring these factors across 12 key lending markets.[2] This is a qualitative analysis designed to capture the importance of banks to each market, the availability of alternative sources of finance and the impact of changes in regulation since 2008.

We look first at the 'banking intensity' of different credit categories, assessing the extent of banks' participation – and the availability of potential substitutes – in both the origination of credit and the holding of credit risk on banks' balance sheets. To do this we use a simple scale, assigning a zero to markets that have robust alternative sources of credit, or to those where credit is largely held off banks' balance sheets; one point to markets where banks dominate in either or both origination and credit retention; and a half point to markets where origination and risk retention are split between banks and other providers.

Next, we evaluate the degree and extent to which regulatory change has affected each market, adding an incremental half point if bank lending is affected in either of two ways:

- Capital costs are effectively higher due to increases in direct capital charges, higher risk-retention requirements or other legal or regulatory restrictions. Examples include the Basel III treatment of mortgages through operational risk and the Federal Reserve's treatment of unfunded commitments in CCAR (the annual Comprehensive Capital Analysis and Review) and its supplementary leverage ratio rule.
- Credit exposures have effectively been brought back on banks' balance sheets as banks face the imposition and enforcement of 'special representations and warranties,' along with greater legal risk. Mortgage settlements are the prime example.

[2] We focus on 12 markets, which together account for roughly $20trn of the total $27trn in non-financial, non-government debt outstanding in the US, according to the Federal Reserve.

We aggregate scores on these three measures to derive an estimate of the total exposure of each market to regulatory change. Markets with two points are most affected; markets with zero points are least affected.

Exhibit 1: Assessment of banking intensity and regulatory changes across key lending markets

	Assessment of banking intensity and regulatory change			
Lending category	**(A) Reliance on banks for origination and/or holding (0, 0.5, 1)**	**(B) Higher effective capital charges (0 or 0.5)**	**(C) Special reps and warranties or higher scrutiny (0 or 0.5)**	**Ranking (A+B+C)**
Near- and sub-prime credit card	1.0	0.5	0.5	**2.0**
Prime credit card	1.0	0.5	0.0	**1.5**
Home equity	1.0	0.5	0.0	**1.5**
Jumbo mortgage	1.0	0.0	0.5	**1.5**
Small unrated corporate loan	1.0	0.5	0.0	**1.5**
Class B commercial real estate (CRE)	1.0	0.5	0.0	**1.5**
Conforming mortgage	0.5	0.0	0.5	**1.0**
Medium unrated corporate loan	0.5	0.5	0.0	**1.0**
Auto	0.5	0.0	0.0	**0.5**
Federal Housing Administration (FHA)/ Veterans Affairs Department (VA) mortgage	0.0	0.0	0.0	**0.0**
Large investment grade corporate	0.0	0.0	0.0	**0.0**
Large high yield corporate	0.0	0.0	0.0	**0.0**

Source: Goldman Sachs Global Investment Research.

Our next step is to identify changes in lending rates, shown in Exhibit 2. We compare the prevailing interest rate in each category in 2013 against the average over 2000-2007, which we use as a non-crisis baseline.[3] To adjust for the overall level of interest rates across loan maturities, we use the relevant non-bank benchmark rates for each activity, namely US Treasuries of differing maturities. The relevant benchmarks and the proxies we use for each category of activity are laid out in Appendix B.

[3] These are prevailing market rates, not specific to any type of lender. Because we focus on relative pricing, not absolute costs, our results are largely insensitive to the choice of baseline time period.

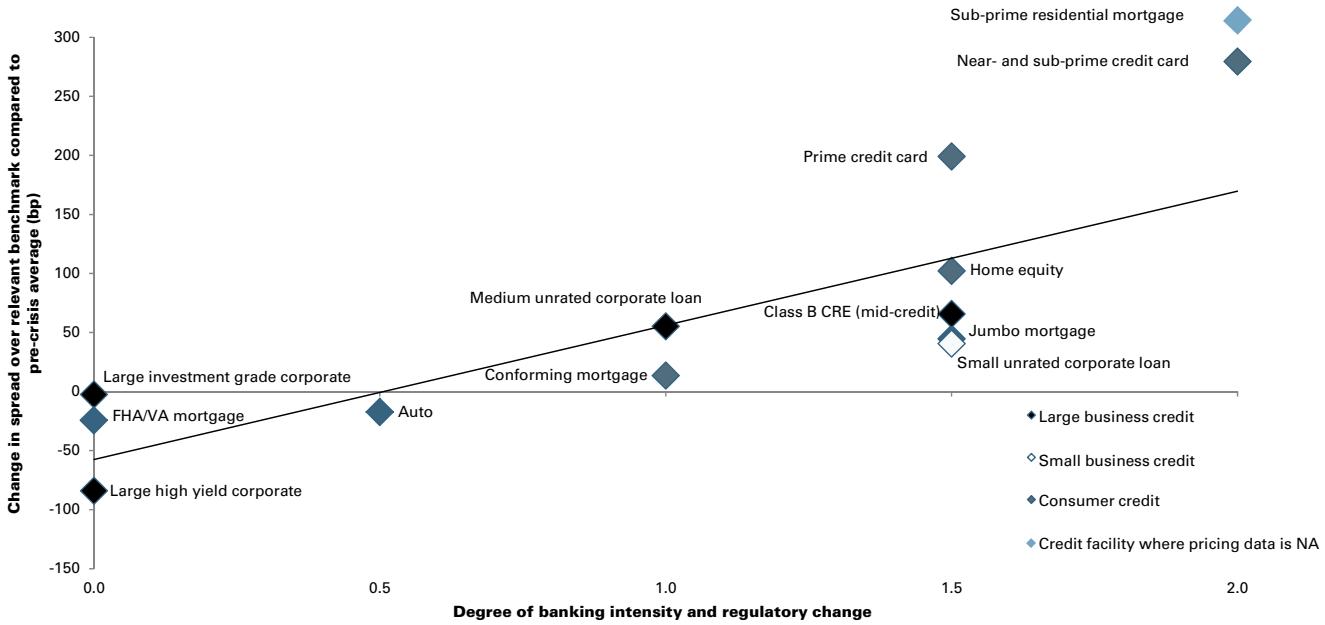
Exhibit 2: Lending rates have risen significantly for most markets compared to the 2000-2007 average
prevailing lending rates, expressed as spreads over applicable benchmark

Form of lending	Price (spread over applicable pricing benchmark)			
Loan/borrower type	**2000-2007**	**2008-2010**	**2013**	**13 vs. pre-'08 (bp)**
Credit card	10.6%	13.2%	12.8%	224 bp
Higher FICO	9.6%	10.8%	11.6%	199 bp
Lower FICO	10.3%	13.3%	13.1%	280 bp
Residential mortgage	--	--	--	--
Jumbo	1.7%	3.0%	2.1%	45 bp
Conforming	1.7%	1.9%	1.8%	14 bp
FHA/VA	1.8%	2.1%	1.6%	-24 bp
Sub-prime	--	--	--	--
Auto	3.4%	4.3%	3.3%	-17 bp
Home equity	2.7%	4.5%	3.8%	102 bp
Commercial real estate	--	--	--	--
Class A (higher-credit)	--	--	--	--
Class B (mid-credit)	1.7%	2.6%	2.3%	66 bp
Smaller CRE	--	--	--	--
Commercial & industrial	--	--	--	--
Large IG corporates	1.5%	2.7%	1.5%	-2 bp
Large HY corporates	5.5%	9.3%	4.7%	-84 bp
Medium unrated corporate	3.5%	5.6%	4.1%	55 bp
Small unrated corporate	2.4%	3.3%	2.8%	41 bp
Average	4.6%	6.1%	5.3%	68 bp

Source: Goldman Sachs Global Investment Research. See Appendix B for relevant proxies and benchmarks.

Finally, we combine these analyses to assess the impact of the regulatory tax burden by plotting the assessment of regulatory change against the change in prevailing lending rates. Exhibit 3 shows the results, which are both large and uneven across different markets. **The markets that are most exposed to regulatory change have seen lending rates rise most significantly, while the markets that are least exposed – where strong non-bank alternatives exist – have seen lending spreads fall from the pre-crisis period.**

Exhibit 3: Rates have risen most in the markets that are most exposed to regulatory change
change in prevailing lending rates, compared to pre-crisis levels, plotted against our assessment of the degree of banking intensity and regulatory change in 12 key lending markets



Source: Goldman Sachs Global Investment Research.

III. Lower-income consumers and small businesses are paying more as a result of new bank regulation

As shown in Exhibits 1 through 3, different dynamics are playing out across the consumer and corporate lending markets, reflecting differing levels of regulatory scrutiny and degrees of banking intensity. But the overall conclusion is clear: consumers and businesses with few alternative sources of finance bear a disproportionate burden of the tax from increased bank regulation.

This is true even in markets where bank regulation has changed lending dynamics for consumers of all income levels and commercial borrowers of all sizes. Consumers with savings or businesses with strong balance sheets can effectively act as their own alternative source of finance – i.e. they can choose to rely on their savings or reserves rather than borrow at excessively high rates. In contrast, consumers who lack a financial cushion have little choice but to pay the higher rates, or to cut spending. In either case, their overall consumption will be lower.

Consumer lending markets

First, consider the **automobile loan market**, which has been largely untouched by regulatory reform and which therefore provides a useful baseline to assess whether factors other than regulation have affected lending or rates. Although a considerable share of the auto financing market is served by captive finance companies, which principally fund themselves in public markets through unsecured term debt and asset-backed securities, banks also play a direct role in auto financing. We estimate that banks originate and hold

on their balance sheets roughly one-third of the total market, and accordingly assign this market a banking-intensity score of 0.5. With no significant post-crisis regulatory intervention, we do not add any incremental points. Looking at the cost of direct bank financing, which is a reasonable proxy for the overall market, we see that spreads over the benchmark have narrowed by 17bp against the pre-crisis level, making auto loans one of the few consumer markets where funding is less expensive today than prior to the crisis.

Second, in clear contrast, consider the **credit card market**, where new regulations affect consumers across the board, and where lower-income borrowers are hurt most. Credit card debt is originated almost entirely by banks, with roughly 70% of it held on banks' balance sheets, giving a banking intensity score of one to each of the three segments we look at (prime, near-prime and sub-prime). All three categories bear higher effective capital charges, for which we assign an additional half point; the near-prime and sub-prime markets have also felt the effects of heightened legal and regulatory scrutiny, for which we assign a further half point. This makes near- and sub-prime credit cards, with a total score of two points, the most affected of the 12 lending markets we discuss in this paper.

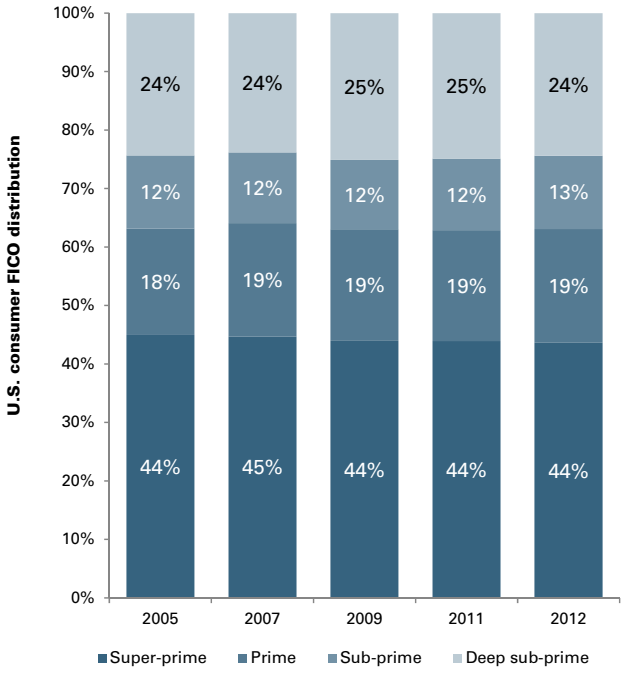
Credit card pricing and availability have been dramatically affected both by the Credit CARD Act of 2009 (the CARD Act) and, more recently, by scrutiny from the new Consumer Financial Protection Bureau. The CARD Act has notably reduced the availability of credit cards for lower-income and younger borrowers. It eliminated banks' ability to reprice credit to reflect actual delinquency. In the past, if borrowers missed payments, card companies could raise their rates to reflect the higher risk from the actual delinquency. Today, card companies are prevented from doing so, meaning that they need to charge higher rates from the outset in order to compensate for the *potential risk* that a borrower might miss a payment at some time in the future.

Exhibit 2 above illustrates the dynamics of credit card pricing in recent years, showing that lower-income borrowers have been most affected. Rates have risen significantly with spreads now at least 200bp wider than the pre-crisis period, even for prime borrowers. And the differential by FICO scores (and implicitly by income)[4] has widened most significantly, as spreads for borrowers with low FICO scores have expanded 280bp.

However, a focus on pricing obscures the fact that many would-be borrowers have been priced out of the credit card market entirely. Outstanding credit card debt is 14% lower than the pre-crisis peak, with the data strongly suggesting that lower-income borrowers have been most affected. As Exhibits 4 and 5 below show, the distribution of FICO scores has been stable since 2005, but the availability of credit cards has shifted dramatically, with upper-income households now dominating the market. In 2005, 26% of the credit extended went to sub-prime or deep sub-prime credit (FICO scores of 660 or below); this figure is just 11% today. The market is currently dominated by 'super-prime' borrowers (FICO scores of roughly 720-850), who account for 58% of the credit outstanding, up from 40% in 2005.

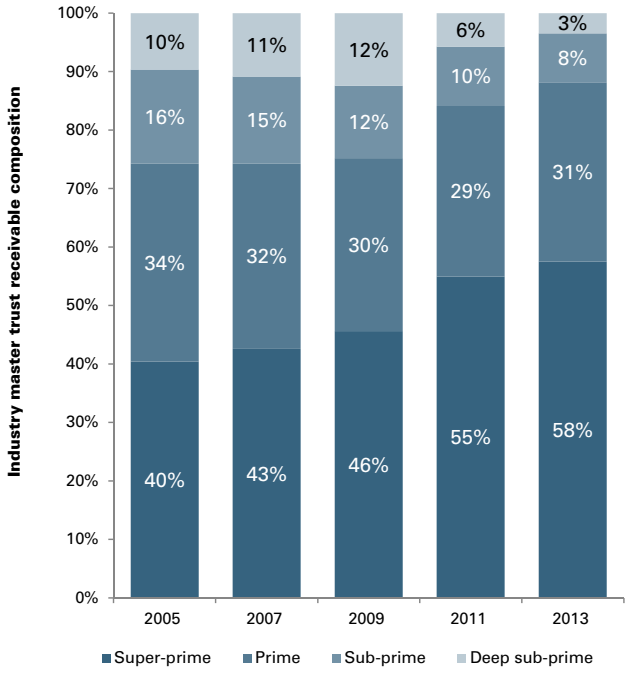
[4] Although FICO scores do not translate directly into income, a paper from the Federal Reserve Banks of Boston and Kansas City suggests that sub-prime and deep sub-prime card holders have incomes below $50,000, while super-prime card holders have incomes above $75,000. See *Effects of Credit Scores on Consumer Payment Choice*, Fumiko Hayashi and Joanna Stavins, Federal Reserve Bank of Kansas City Research Working Paper RWP 12-03, February 2012.

Exhibit 4: The distribution of FICO scores across US consumers has been relatively stable…



Source: Goldman Sachs Global Investment Research, Fair Isaac Corporation, company master trust filings. US consumer FICO distribution: super-prime (720-850), prime (660-720), sub-prime (600-660), deep sub-prime (<600).

Exhibit 5: …but the distribution of credit cards is shifting towards prime borrowers



Source: Goldman Sachs Global Investment Research, Fair Isaac Corporation, company master trust filings. US consumer FICO distribution: super-prime (720-850), prime (660-720), sub-prime (600-660), deep sub-prime (<600).

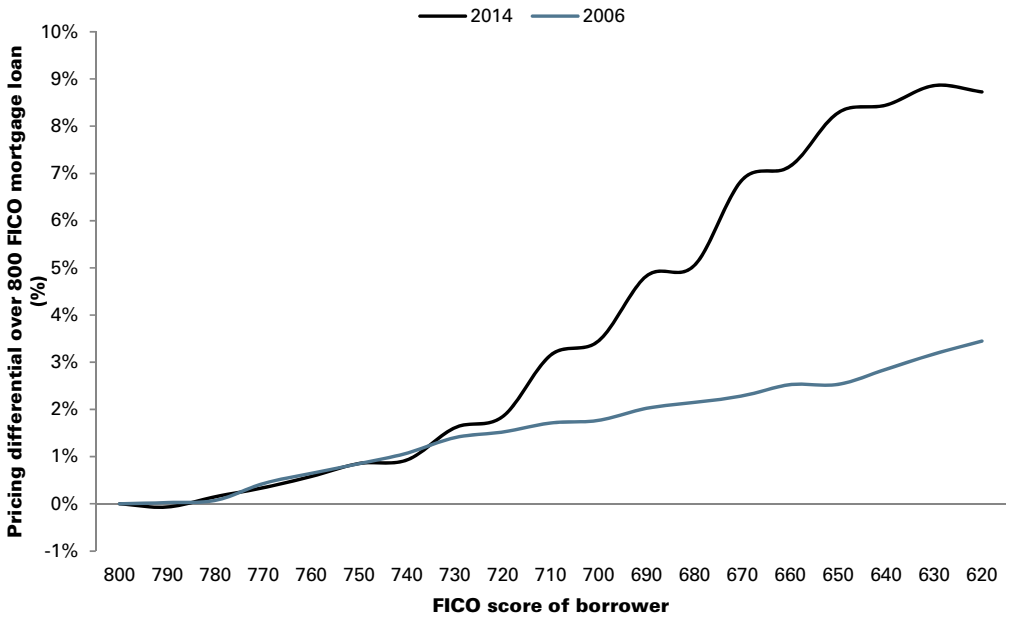
Many low-income borrowers who have been priced out of the credit card market entirely have turned to alternative sources of credit – but in this case their alternatives are payday lenders, pawnshops and other non-bank sources where borrowing costs are typically far higher. Data from US Census Bureau surveys indicate that the universe of borrowers from non-bank sources has expanded significantly during the downturn. The demographic composition of borrowers also changed, becoming increasingly older, non-minority and more educated, and with more married couples and higher-income households relying on non-bank credit as well.[5] Forty-five percent of recent users indicated in the survey that they had turned to non-bank credit to meet basic living expenses. These borrowers may be able to maintain their previous levels of consumption, but at a high cost: interest rates from non-bank lenders tend to have annual percentage rates (APRs) that run to three digits, rather than the 15%-30% rates typically seen with credit cards.

Third, consider the **conforming mortgage market**, where rates have risen and low-income borrowers may be unable to obtain credit as a result of new rules and regulations. Mortgage origination is split between banks and non-bank lenders, and mortgages are held both on banks' balance sheets and by non-bank investors. Accordingly, we assign a banking intensity score of 0.5. Mortgages are also now subject to heightened scrutiny in several forms: new rules on 'qualified mortgages' and higher risk-retention requirements for non-qualifying mortgages; heightened repurchase risk; and stricter regulatory scrutiny of pre-crisis underwriting practices. For these factors, we assign another half point.

[5] See the 2011 *FDIC National Survey of Unbanked and Underbanked Households*, http://www.fdic.gov/householdsurvey/2012_unbankedreport.pdf, as well as its 2013 addendum, http://www.fdic.gov/householdsurvey/2013_AFSAddendum_web.pdf. This report analyses data collected by the US Census Bureau in conjunction with the FDIC.

Overall, spreads for conforming mortgages have expanded 14bp since before the crisis. But this is not an across-the-board increase. Exhibit 6 shows the pricing spread between high-FICO mortgages and low-FICO mortgages. Both are conforming, government-guaranteed mortgages, meaning that there is no credit risk to the lender. Nonetheless, banks charge dramatically different rates for borrowers of different credit quality. Prior to 2008, a borrower with a FICO score of 620 paid roughly 3.5% (or 21bp in absolute terms) more than a borrower with a score of 800. Today, that differential is as much as 8.7% (or 39bp). This effectively prices many lower-credit borrowers out of the conforming mortgage market entirely.

Exhibit 6: The differential between high- and low-FICO mortgage borrowing has widened, even for government-guaranteed loans
pricing spread by borrower's FICO score over an 800 FICO mortgage loan



Source: eMBS, Goldman Sachs Global Investment Research.

In fact the **sub-prime mortgage market** has dried up almost completely since 2008, with just $4bn originated in each of the last five years, compared to $625bn in the peak year of 2005. Banks face higher risk retention requirements and capital charges for these loans, along with heightened regulatory scrutiny around pre-crisis lending practices and repurchase risk. As a result, many banks are no longer willing to participate in this market or will only do so at rates that are prohibitively expensive for borrowers.

The **jumbo mortgage market** also faces heightened regulatory scrutiny, particularly stricter standards for lenders in assessing borrowers' ability to repay. Some lenders have raised down payment requirements and others have pulled back from the business. Originations today are roughly half the 2000-2007 annual average, and spreads have expanded 45bp. Jumbo mortgages are an important segment of the market in states with higher average home prices.[6]

[6] States where more than 15% of houses are valued at more than $500,000 include California, Connecticut, Hawaii, Maryland, Massachusetts, New Jersey, New York and Virginia.

The related **home equity market** also illustrates these dynamics well. Banks are responsible for virtually all origination of home equity loans and hold roughly 85% of the risk on their balance sheets; we give this market one point on the banking intensity scale. Home equity also receives an incremental half point for special regulatory scrutiny, in the form of higher risk weights through operational risk and CCAR, and thus effectively higher capital charges, along with higher risk-retention requirements. Together, with a lack of MBS investor appetite, these factors have pushed pricing sharply higher (with spreads expanding 102bp relative to the pre-crisis average) and originations dramatically lower (roughly 20% of the pre-crisis annual average).

Bank regulation has had the effect of expanding credit availability in one segment of the market: mortgages guaranteed by the Federal Housing Administration (FHA) and Veterans Affairs Department (VA). **FHA/VA loans** are offered on flexible terms (recently made more flexible) to low- or no-credit borrowers (FHA) or to veterans (VA), and their guaranteed status gives them no repayment risk. Effectively this market has become a government-guaranteed substitute for the private sub-prime market. Not surprisingly, origination, which largely occurs within banks, has soared and is now more than two and a half times the pre-crisis average. Pricing has also improved, with spreads 24bp narrower than pre-2008 levels. These loans make up less than 20% of the total mortgage market, but they illustrate the way in which policy interventions have shifted the allocation of credit.

Exhibit 7 shows the changes in origination activity in different segments of the mortgage market.

Exhibit 7: FHA/VA loans supplant sub-prime mortgages
change in origination ($bn)

	Loans originated by banks ($bn)			
Loan/borrower type	**Average 2000-2007**	**Average 2008-2010**	**Total 2013**	**13 vs. pre-'08 (% change)**
Residential mortgage	$2,693	$1,657	$1,890	-30%
Conforming	$1,296	$1,074	$1,175	-9%
Jumbo	$482	$100	$272	-44%
Sub-prime	$341	$10	$4	-99%
FHA/VA	$138	$374	$366	164%

Source: Goldman Sachs Global Investment Research, Inside Mortgage Finance.

Corporate funding markets

Switching our focus to commercial lending, we see a clear differentiation between the larger firms that have ample access to alternative sources of funding, often at attractive rates, and the small and mid-sized firms that are much more reliant on banks and, consequently, are paying more for credit today.

Consider **commercial real estate (CRE)** lending. This is a highly bank-intensive business, to which we assign one point, along with a further half point for higher capital requirements. The volume of debt outstanding is down by more than 20% in both the Class B (non-super-prime commercial real estate) and smaller CRE markets, while spreads for the Class B market have widened by 66bp, suggesting that even those borrowers who can get credit are paying notably more.

Also observe the sharp disconnect by size within **commercial and industrial (C&I)** lending. At one end of the spectrum are the **smaller unrated corporate loans**. Because banks originate 100% of this market and hold 100% of the risk on their balance sheet, we give this market one point for banking intensity. The market gains another half point for the impact of the Basel III leverage ratio's treatment of unfunded commitments. Credit is still available,

with the total debt outstanding today 6% higher than the pre-crisis peak, but spreads have expanded by 41bp. This suggests that smaller unrated corporates continue to borrow from banks because they lack effective alternatives, but that they are paying considerably more for credit today.

The picture is slightly different in the **mid-sized unrated corporate loan market**. We assign a half point for banking intensity, given that while banks still originate close to 100% of these loans, the growing role of alternative providers from the asset management industry has driven the share of risk held on banks' balance sheets to just 19% today, down from nearly 50% prior to the crisis. We also assign an incremental half point for regulatory changes in the market, particularly CCAR treatment and new limits on leveraged lending imposed in 2013. Bank pricing in the mid-sized corporate market has expanded by 55bp, suggesting again that corporates with few alternatives to banks are paying notably more for credit today.

At the other end of the spectrum are the large corporations that can borrow in **public debt markets** – both investment grade (IG) and high yield (HY). Banks do not play a role in originating IG or HY debt, other than in underwriting, and hold less than 5% of the total market risk on their balance sheets. Not surprisingly, we assign zero points for such low banking intensity. We also do not assign incremental points for special regulatory or judicial scrutiny, because these markets have been largely unaffected by the regulatory changes aimed at banks.

Large IG and HY corporates today have access to funding at rates that are considerably more attractive than prior to the crisis. In fact, large high yield corporate debt shows the largest improvement in funding costs across the 12 markets we assess (with spreads 84bp narrower than before the crisis). Lower funding costs have not surprisingly attracted a broader range of issuers in the wake of the crisis, with some firms that had previously been reliant on bank debt shifting their funding mix towards bonds, new entrants joining the market and in some cases companies issuing public debt to pay down bank borrowings. Private placements have also provided an important source of financing for some larger corporates. However, it is important to note that public debt issuance itself carries an additional regulatory and compliance burden, meaning that it is not available for all firms. Here too, size is a key factor in determining whether firms can access the lower borrowing rates that bond markets now offer.

The strength of the public debt markets can be seen in numerous ways. Yields are at historic lows across the credit spectrum, while issuance is reaching all-time highs in both the IG and the HY markets. Firms are financing on very attractive terms, including 'covenant-lite' and payment-in-kind (PIK) deals and dividend recapitalizations. New and infrequent issuers are raising funds at rates that would have been unavailable just a few years ago. Strong inflows into these markets reflect investors' demand for yield and market resiliency, as well as the entrance of non-traditional lenders such as hedge funds and insurance companies, who are beginning to disintermediate banks.

IV. Putting the cost of new bank regulation into economic context

To put our analysis into a broader economic context, we look at the impact of lower availability and higher cost of credit across both consumer and corporate borrowers. We begin with consumers by examining the effects of new bank regulation on a household with the US median annual income of $50,000. We estimate that the higher payments associated with the types of mortgages and credit card debt this household would consume, offset by lower auto loan payments, equates to an incremental $200 in interest expenses each year.[7]

A household in the 20th-40th percentile by income, which earns $38,000 on average, fares worse. We assume it does have access to credit but note that more than 40% of these households do not. If the household does have credit, it may pay an incremental $300 each year for its mortgage and credit card debt, even considering the offsetting reduction in auto payments. This means that the relative impact is almost twice as large as it is for the median household: 80bp of annual income compared to 40bp. For a minimum-wage earner working eight hours a day, $300 is a full week's worth of work.

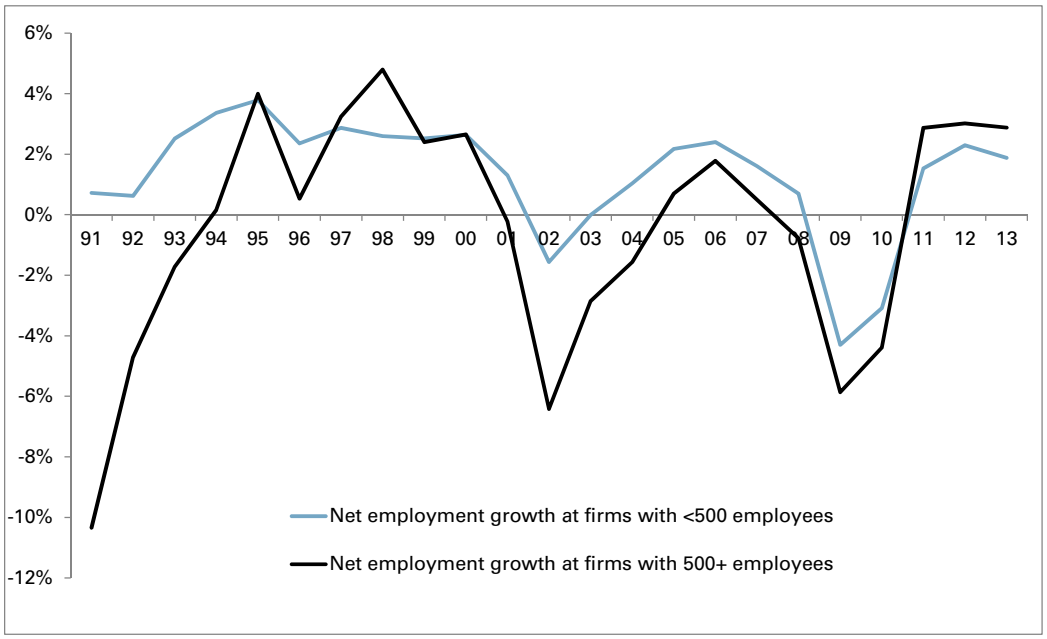
Turning to corporates, small businesses[8] tend to fund themselves through a mixture of credit card debt, bank loans and bank lines of credit. Credit cards are a principal source of funding for most small businesses, given that many have limited access to bank finance. Therefore these firms are hurt by higher credit card rates and lower availability of credit, as well as by higher borrowing rates for bank loans and lines of credit.

The actual costs of higher credit for small businesses are difficult to tabulate, given the lack of detailed data on the distribution of small firms' sources of borrowing. However, cost itself is not the key concern – the principal issue is small firms' ability to compete with larger businesses. In fact, some of the most striking macroeconomic implications of our analysis stem from the disparity between funding costs for small and large businesses. Smaller firms are considered the key driver of job creation, particularly when assessed by the number of local employees per dollar of revenue, given that they are typically more labor-intensive than large firms. Exhibit 8 illustrates the fact that small firms have lagged large firms in job creation since the start of the post-crisis economic recovery, which is a break from the historical norm and may reflect the competitive funding dynamics.

[7] Relying on Census Bureau data, we look at the median characteristics of a US household of three people. This household has annual income of $50,000 and debt outstanding of $130,500. We use the median levels of household debt outstanding, specifically home debt of $117,000, credit card debt of $3,500 and an auto loan of $10,000). We apply the relevant increase in spreads (mortgage +14bp, credit card +199bp, and auto loan -17bp) to each category to identify the increased interest expenses.

[8] The US has a total of 28 million small businesses, of which roughly 23 million are owner/operator businesses; the remaining 5 million have at least one employee in addition to the owner/operator (termed 'employer firms'). According to the US Census Bureau, the overwhelming majority (99.7%) of employer firms in the US have fewer than 500 employees. These 5 million 'small' businesses collectively employ approximately 55 million people and have an annual payroll of $2.2 trillion.

Exhibit 8: Job creation for small firms is lagging in this recovery, in a break from the historical pattern
year-on-year net change in employment



Source: Goldman Sachs Global Investment Research, Bureau of Labor Statistics.

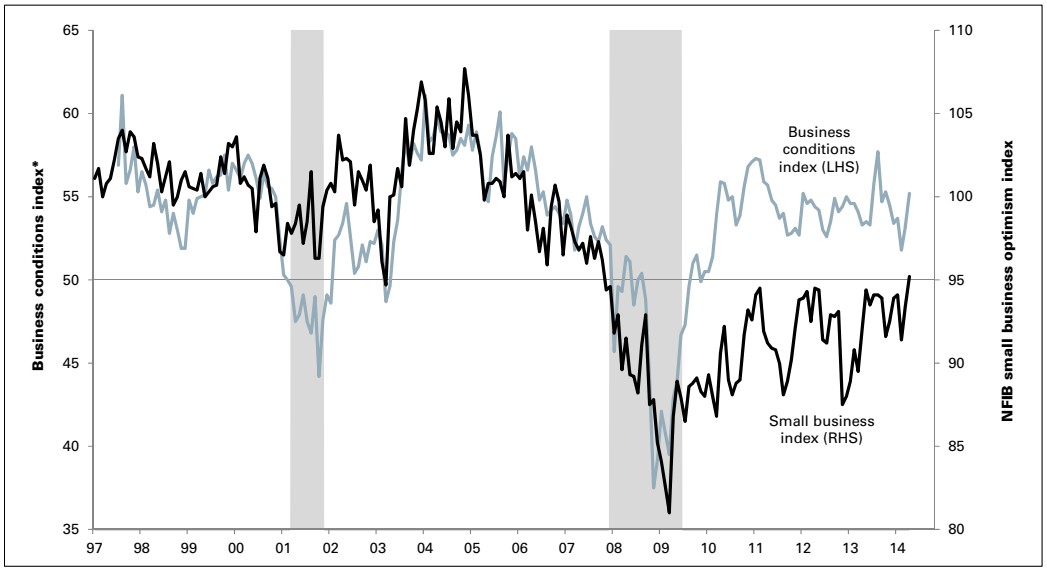
These competitive dynamics are even more apparent in the divergence between the Institute for Supply Management's (ISM) purchasing managers' index, which measures the overall health of large firms based on five indicators,[9] and the small-firm equivalent from the National Federation of Independent Businesses (NFIB).[10] Before the crisis, these two indices tracked quite closely, but since then the large-firm ISM has indicated strong growth and a fairly normal cyclical recovery, while the small-firm index indicates that smaller firms have remained in recession. See Exhibit 9.

A similar demonstration of the way in which large firms have fared better than their smaller counterparts during an economic recovery that has significantly lagged historic norms is the performance of revenues for S&P 500 non-financial firms. These have actually been at the top end of the historical range for a cyclical recovery, suggesting that large firms have taken significant market share from small and mid-sized firms. See Exhibit 10.

[9] The ISM's monthly composite index is based on five indicators: new orders, production, employment, supplier deliveries and inventories.

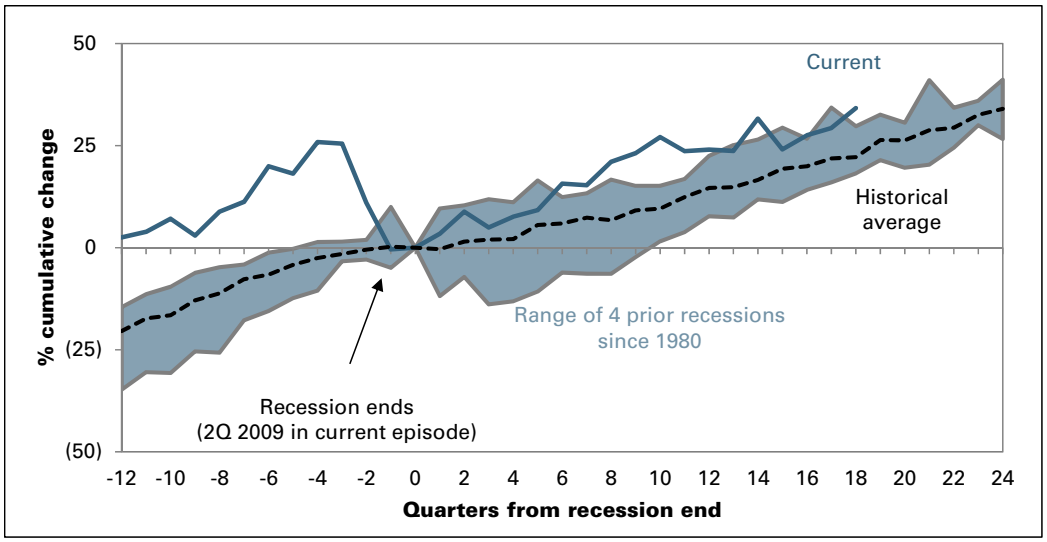
[10] Indicators underlying the NFIB survey are plans to increase employment, capital outlays and inventories; expectations for the economic outlook, sales, credit conditions and expansion; and current inventory, job openings and earnings trends.

Exhibit 9: Optimism is rising among large firms, but still lagging among small firms
shaded areas indicate recessionary periods



Source: Goldman Sachs Global Investment Research, Institute for Supply Management, National Federation of Independent Business, NBER. (*) Weighted average of manufacturing and nonmanufacturing indices.

Exhibit 10: S&P 500 non-financials' sales are at the top end of the historical range
cumulative % change in sales from end of recession



Source: Goldman Sachs Global Investment Research.

Banks and their shareholders pay too

As with any form of tax, the cost is ultimately borne by the targeted firms as well as by their customers. So although our analysis has focused on the overall economic impact, it is important to note that banks themselves have also paid the cost of increased regulation. There are direct costs, including compliance and back-office operations that have expanded significantly to address new rules, including the Volcker Rule and derivatives clearing. Ex-post scrutiny into pre-crisis mortgage practices, among other issues, has led five of the six largest US banks to provision nearly $80bn in aggregate legal reserves since 2010, according to company filings.

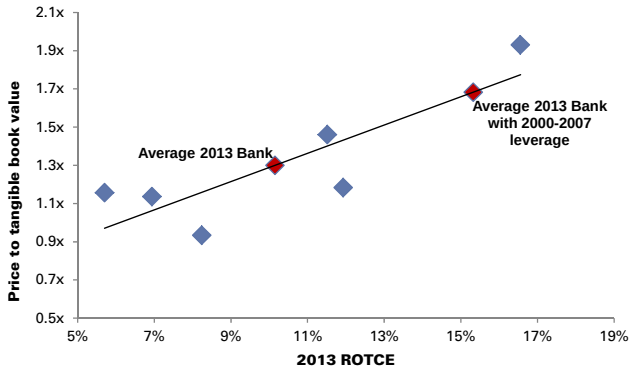
While not the focus of our study, we note that bank shareholders have also paid a price for increased regulation. Between late 2008 and the end of 2009, the six largest US banks raised nearly $170bn in fresh equity, diluting existing shareholders by at least 5% and as much as 82% in the most extreme case (see Exhibit 11). The additional capital has contributed to a sharp fall in those banks' return on tangible equity (RoE), which is now 10% on average, against an average of 31% for the 2000-2007 period. Lower RoEs have in turn reduced bank equity valuations and thus the value of bank shares. We estimate that the observed decline in the six largest US banks' ROE over this period has reduced the value of their shares by more than 20%. See Exhibit 12.

Exhibit 11: Shareholders of the six largest US banks have been significantly diluted
common equity raised by six largest US banks 2008-2009

Bank	TARP funds received ($bn)	Common equity raised ($bn)	Common equity raised as % of TARP funds	Common share count dilution
Bank of America	45	48	106%	37%
Citigroup	45	83	184%	82%
Goldman Sachs	10	6	58%	9%
JP Morgan	25	6	23%	5%
Morgan Stanley	10	5	46%	20%
Wells Fargo	25	21	83%	18%
Total	160	167	104%	29%

Source: Goldman Sachs Global Investment Research, SNL Financial, company presentations. Common shareholder dilution is calculated as the change in common equity shares from the time of the initial TARP receipt until the final TARP repayment. Bank of America figures include funds it received after its acquisition of Merrill Lynch.

Exhibit 12: The average price-to-tangible book multiple for the six largest US banks has contracted by more than 20% vs. pre-crisis levels



Source: Goldman Sachs Global Investment Research, FactSet.

V. Conclusion

It is important to note that we do not attempt to analyze whether the new lending rates are better or worse characterizations of risk than the pre-crisis rates. Our calculations simply show the degree to which new rules and regulations have affected lending and where those effects have been most acute within the economy. The normative conclusion that can be drawn from the role of market substitutability is that markets and regulators differ meaningfully in their assessment of risk. For example, the relative normalcy of auto lending, which is one of the bright points in the current economic cycle, suggests that the regulatory burden of new bank regulation bears much of the responsibility for changes in pricing across the rest of the consumer lending categories we assess. Increased bank regulation has had real economic impacts and may be a significant contributing factor to the ongoing sluggishness of consumer spending. A similar story can be told in the commercial lending markets, where the economic recovery for the large firms that now enjoy a substantial funding advantage has been rapid and generally in line with previous economic cycles, while the small and mid-sized businesses that are more dependent on banks have lagged substantially.

Appendix A: Select rules and regulations applicable to US banks enacted since 2008

Capital requirements and planning; liquidity restrictions; enhanced prudential standards

- Basel III risk-based capital requirements and revisions to risk-weightings
- G-SIB capital surcharges and US-based SIFI capital surcharges
- Leverage ratio
- Comprehensive Capital Analysis and Review (CCAR): capital plans, risk-based capital requirements, leverage constraints, annual stress tests (among other components)
- Net Stable Funding Ratio (NSFR)
- Liquidity Coverage Ratio (LCR)
- Resolution planning ('living wills')
- Supervisory guidance on leveraged lending activities
- Single-counterparty credit limits

Consumer protection

- Credit CARD Act
- Durbin Amendment (interchange rule)
- Qualified Mortgage/Ability to Repay rule

Securitization

- Credit risk retention requirements
- Due diligence analysis and disclosure requirements for asset-backed securities

Structure and activity restrictions

- Volcker Rule restricting proprietary trading

Regulation of over-the-counter (OTC) derivatives activities, including (but not limited to):

- Mandatory central clearing
- Trade execution (regulated platforms)
- Trade reporting to data repositories
- Margin requirements for uncleared derivatives
- Business conduct standards
- Registration of securities-based swap dealers and swap dealers
- Treatment of cross-border transactions

Appendix B: Benchmark maturities and proxies used in our analysis

Exhibit 13: Summary of proxy used for each lending market and the relevant risk-free benchmark

Key lending markets		
Loan/borrower type	**Proxy used**	**Risk-free benchmark**
Credit card		
Higher FICO	Gold/platinum card APR offerings	1-Year Treasury
Lower FICO	Standard card APR offering	1-Year Treasury
Residential mortgage		
Conforming	Average GSE-eligible mortgage rate	10-year Treasury
FHA/VA	Average FHA-eligible mortgage rate	10-year Treasury
Sub-prime	Subprime private-label MBS	10-year Treasury
Jumbo	Bankrate - 30 year loans	10-year Treasury
Auto	Commercial bank - new car loan	5-year Treasury
Home equity	Mid-price HELOC via bankrate.com	10-year Treasury
Commercial real estate (CRE)		
Class A (higher-credit)	Life insurance com. mortgages	10-year Treasury
Class B (mid-credit)	CMBS conduit com. mortgages	10-year Treasury
Smaller CRE	Domestic bank CRE loans	10-year Treasury
Commercial & industrial		
Large investment grade corporate	iBoxx IG corporate bonds	Applicable Treasury (1)
Large high yield corporate	BAML/Barclays high-yield indices	Applicable Treasury (1)
Medium unrated corporate	S&P leveraged loan index	3-month Treasury
Small unrated corporate	Domestic bank C&I loans	3-month Treasury

Source: Goldman Sachs Global Investment Research, Inside Mortgage Finance, Bankrate, Federal Reserve, Mortgage Bankers Association, Standard & Poor's, iBoxx, Bloomberg. (1) Each bond in the IG index is measured against the appropriate benchmark Treasury, determined by the bond's maturity date. The spread in the HY index represents the option-adjusted spread (OAS).

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The two-speed economy

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I. The changing shape of the US economy

Although recent economic data have generally begun to improve, the pace of the post-crisis recovery has been far weaker than the historical pattern suggests it should be. We estimate that if the current recovery had followed the historical norm seen in US economic cycles since 1980, GDP growth since the end of the crisis in mid-2009 would be nearly nine percentage points higher today, and roughly five million more jobs would have been created over the course of the recovery.

Macroeconomic factors have weighed heavily on post-crisis economic growth. These include demographic changes and housing and fiscal headwinds, which together account for roughly 75% of the weakness seen this recovery relative to the historical norm, according to our US Economics research team.[1] However, looking at "the recovery" solely from the macroeconomic perspective overlooks the significant differences in how it has played out across various parts of the economy. The quality of the recovery has varied widely for large and small firms – and for the people who work for them – and perceptions of the strength of the recovery have tended to follow personal experience rather than the macroeconomic average.

Specifically, when we look beneath the economy-wide numbers, we see that large corporations have performed well, generating strong revenue growth, rising employment and robust wage growth. Small firms, in contrast, have suffered low rates of business formation and tepid employment growth. Employees of small firms have also seen significantly weaker wage growth than employees of large firms have enjoyed.

The two-speed economy is evident across a broad range of data.[2] Revenues for the S&P 500 (ex-financials) grew roughly 6% annually between 2009 and 2014, well above the average for the prior four recoveries, while small businesses haven't yet fully recovered from the recession. Survey data suggest that growth rates for small firms have only recently shown signs of converging toward the growth rates indicated by large firm surveys.

Perhaps the simplest and most economically significant demonstration of the challenges facing smaller firms is that the number of these businesses actually declined over the five years from the start of the crisis – the only such decline since the data became available in the late 1970s. The result is an estimated 600,000 "missing" small firms, and six million jobs associated with these firms, as of 2012. Although it is unclear what percentage of these jobs were truly lost – as some might have been absorbed by large firms – this dynamic nevertheless represents a meaningful structural shift in the economy.

Employment data tell a similar story. Available US Census Bureau data show that jobs at firms with more than 500 employees grew by roughly 42,000 per month between 2010 and 2012, exceeding the best historical performance over the prior four recoveries. In contrast, jobs at smaller firms declined by roughly 700 per month over the same period, a sharp contrast to the average monthly growth of roughly 54,000 jobs over the prior four recoveries. While the US Census Bureau data is only available through 2012, it enables us to quantify the relative shift in the share of employment between large and small firms. Other data series – such as small business surveys, the US Bureau of Labor Statistics (BLS)

[1] The Goldman Sachs US Economics team has published extensively on the macroeconomic factors affecting the recovery. For example, see Hatzius et al, *"US Economics Analyst: Sticking with Stronger,"* May 2014; Hatzius et al, *"US Economics Analyst: More Cyclical than Secular,"* December 2013; Mericle, *"US Daily: Assessing the Slowdown in Potential Growth,"* November 2013.

[2] Given the wide scope of issues we discuss throughout this paper, we rely on a range of data sources covering differing time periods depending on data availability, which in some cases is limited. We use the longest-running data series wherever possible. Throughout the paper we note the relevant timeframe and data source.

firm employment dataset and the household employment survey of sole proprietorships – indicate that there has not been a significant change in these patterns since 2012.

Also significant is the gap that has developed in wage growth between large and small business establishments. Although wages (indexed to 1996 levels) at both large and small establishments increased nearly in tandem during the decade before the crisis, these two figures have since diverged and now reflect a gap of roughly 20 percentage points. This suggests that small businesses continue to struggle, and that their employees may be paying an ongoing price in the form of lost wages.

While there may always be some debate about the complex and lingering nature of the effects of the crisis, particularly on business decisions, the most widely-cited and perhaps the most likely explanation for much of the split that we observe between the performance of large and small businesses is the cumulative impact of the new regulations and related policy actions that have been taken since the crisis.[3]

As we discussed in our June 2014 paper, "*Who pays for bank regulation?*",[4] new banking regulations have made bank credit both more expensive and less available. This affects small firms disproportionately because they largely lack alternative sources of finance, whereas large firms have been able to shift to less-expensive public market financing.

While banking regulation has played a key role, regulation outside of banking has also raised the fixed costs of doing business. It is unclear whether these economy-wide regulations can explain the bifurcation between large and small firms, but regulation would typically have a disproportionate impact on the ability of small firms to compete, despite often subjecting larger firms to notable increases in direct regulatory scrutiny and higher absolute costs. The negative competitive affects for small firms arise because of the relatively fixed-cost nature of complying with regulations; large firms have a much larger volume of business over which to spread higher fixed regulatory costs than do small firms. And even when small firms are formally exempted from regulations, they may still feel the impact because they may effectively be required to meet what soon become de facto standards for the industry as a whole.

Even as large firms experience a relatively robust recovery, they appear to be investing less than we would expect given their historically high profit margins, and investing with a bias toward shorter-term projects; this dynamic may be playing out because large firms are facing less competition from smaller firms. Investments in intellectual property, for example, are tracking nearly five percentage points below even the low end of the historical experience and more than 20 percentage points below the historical average.

Considered in isolation, the negative impacts of each of the rules imposed since the crisis may not be significant. Cumulatively, however, they have had a clear and meaningful impact on the relative competitiveness of small businesses. The question of whether this trade-off is acceptable is both a political and an economic judgment. Taken together, the reduced competitiveness of small firms and the changing investment decisions of larger ones are reshaping the competitive structure of the US economy in ways that are likely to reverberate well into the future, and in ways that any future evaluation of the aggregate effects of post-crisis regulations should consider.

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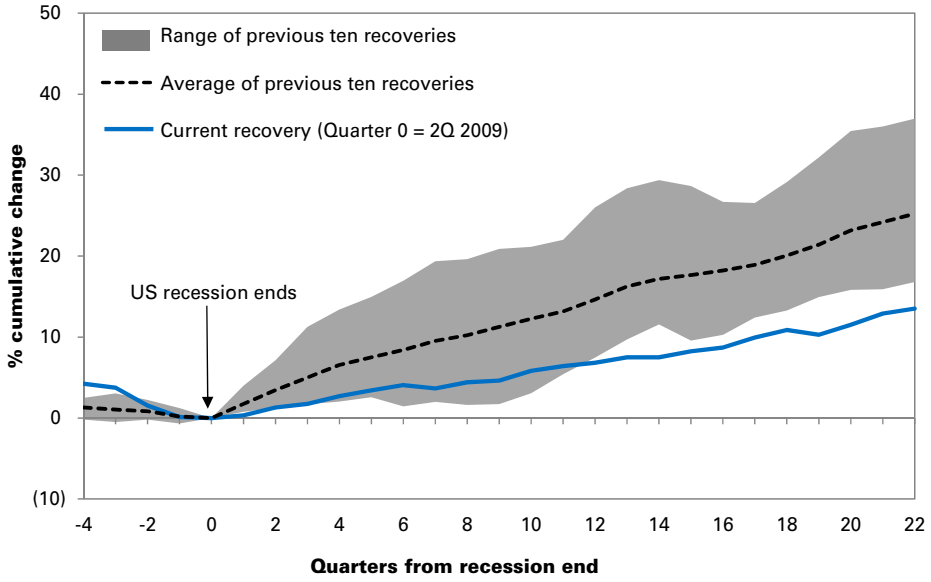
[3] See, for example, Koppl, *"From Crisis to Confidence: Macroeconomics after the Crash,"* December 2014; Duygan-Bump et al, *"Financing Constraints and Unemployment: Evidence from the Great Recession,"* October 2014 and Baker, Bloom and Davis, *"Has Economic Policy Uncertainty Hampered the Recovery?,"* February 2012.

[4] See http://www.goldmansachs.com/our-thinking/public-policy/regulatory-reform/who-pays-for-bank-regulation.html

II. The recovery has been slow and uneven

Although recent macroeconomic data have generally begun to improve, US economic activity since the 2008 financial crisis has lagged previous recoveries by a wide margin (see Exhibit 1). We estimate that if the current recovery had followed the historical norm seen in US economic cycles since 1980, growth in GDP since the end of the crisis in mid-2009 would be nearly nine percentage points higher today than the 14% that has been recorded. A longer time horizon shows an even more dramatic underperformance: the current recovery lags the low end of the historical range of recoveries dating as far back as the late 1940s (see Exhibit 2 for a historical list).

Exhibit 1: The recovery in real GDP lags historical recoveries
Reflects recoveries between 1949 and 2014; growth in real GDP



Source: Bureau of Economic Analysis (BEA), Goldman Sachs Global Investment Research.

Exhibit 2: US recessions since the late 1940s

	Beginning of recession	End of recession	Duration of recession (# of months)
1	November 1948	October 1949	11
2	July 1953	May 1954	10
3	August 1957	April 1958	8
4	April 1960	February 1961	10
5	December 1969	November 1970	11
6	November 1973	March 1975	16
7	January 1980	July 1980	6
8	July 1981	November 1982	16
9	July 1990	March 1991	8
10	March 2001	November 2001	8
11	December 2007	June 2009	18

Source: National Bureau of Economic Research (NBER), Goldman Sachs Global Investment Research.

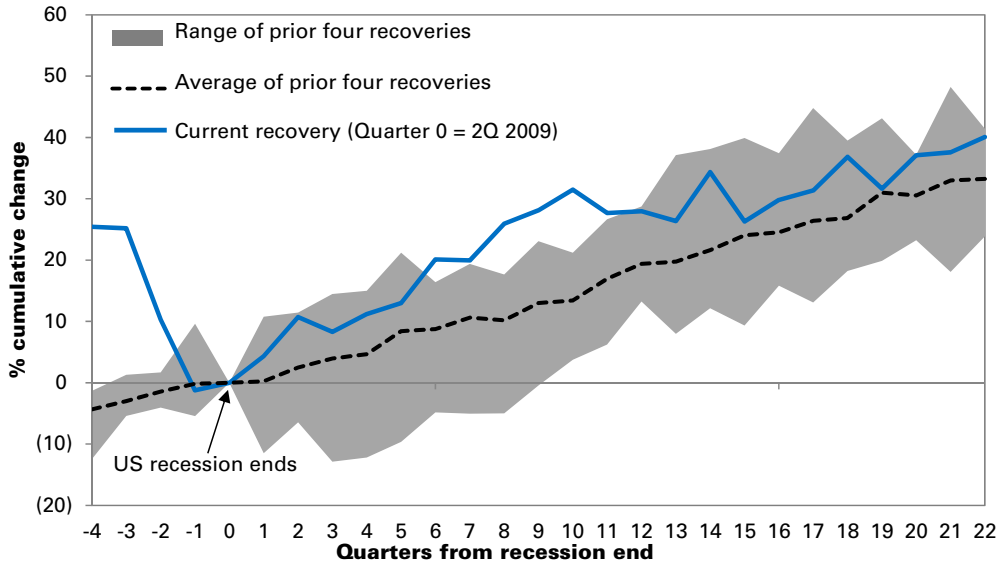
What can explain this anomalous weakness? Several macroeconomic factors have contributed, including demographic changes and housing and fiscal headwinds, which taken together account for roughly 75% of the weakness seen this recovery relative to the historical norm, according to our US Economics team. Yet to speak about "the recovery" overlooks the very different ways it is playing out across different parts of the economy. The recovery felt by large firms and the people who work for them is very different from the recovery felt by small firms and the people who work for them. We see this divergence across a wide range of indicators, as we discuss next.[5]

Large firms outpace small firms in revenue growth

Consider revenue growth since the end of the recession in mid-2009. Although the largest companies, the S&P 500 (excluding financials),[6] saw their revenues decline significantly during the crisis, they have since experienced a recovery in revenue growth that outpaces the historical trend over the past 35 years. The revenues of these firms are 40% higher today than at the end of the recession; this figure is roughly seven percentage points above the average rebound seen at the same point in the prior recoveries since 1980 (see Exhibit 3). Such strong revenue growth for the largest US companies helps to explain why the S&P 500 index has reached all-time highs, despite the generally lackluster recovery.

Using IRS data that is available over a shorter timeframe to examine a broader universe of large US firms – those with more than $50 million in annual revenue – we find that revenues grew 8% on a compounded annual basis between 2009 and 2011. Smaller firms in the same dataset fared poorly in comparison: those with less than $10 million in annual revenues enjoyed only 2% growth over the same timeframe.

Exhibit 3: S&P 500 companies (ex-financials) have experienced historically robust revenue growth since the recession ended in 2009
Reflects recoveries since 1980 (latest available data are as of 4Q2014)



Source: Compustat, Goldman Sachs Global Investment Research.

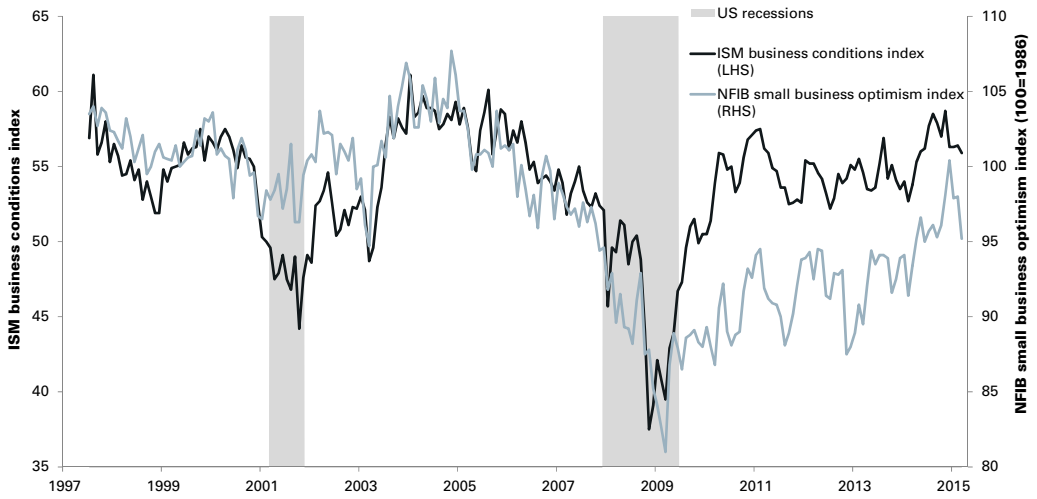
[5] In this paper we define "small" businesses as firms or establishments with fewer than 500 employees. Appendix A shows a different cut-off, defining "small" businesses as those with fewer than 100 employees. The results of our analysis are similar regardless of whether we use 500 or 100 as the cut-off.

[6] Consistent with industry practice that reflects the substantial differences in business models between financial and non-financial firms, we exclude financials from our analysis of the S&P 500.

Surveys indicate that small firm growth has only recently shown signs of converging toward large firm growth

The two key indices of business conditions also reflect a divergence in growth rates between large and small firms, as shown in Exhibit 4. The Institute for Supply Management (ISM) surveys measure business conditions indicative of current and future growth among larger firms, while the National Federation of Independent Business (NFIB) index measures similar metrics among smaller firms.[7] The ISM and the NFIB measures tracked closely from the late 1990s until the crisis, when they began to diverge significantly. While both measures have improved since the recession ended, the NFIB's assessments of conditions and its implied growth rates for smaller firms have only recently shown signs of converging toward those indicated by the ISM.

Exhibit 4: NFIB and ISM surveys indicate that small firm growth has only recently shown signs of converging toward large firm growth



Source: ISM, NFIB, NBER, Goldman Sachs Global Investment Research.

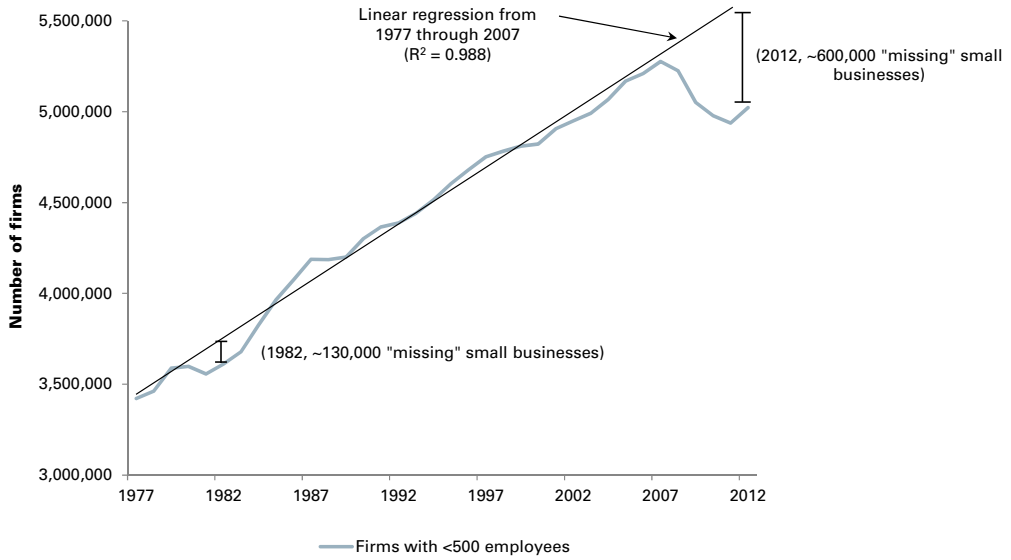
The number of small firms is declining

We see the challenging operating environment for small firms reflected in the decline in the number of these businesses since the start of the crisis. Available US Census Bureau data show that the number of small firms declined over the five years that followed the onset of the crisis – the first such occurrence since the data became available in 1977 (see Exhibit 5).

[7] The NFIB small business optimism index is based on a monthly survey of NFIB member businesses, which are primarily firms with annual gross receipts of less than $10 million (http://www.nfib.com/foundations/research-foundation). The ISM surveys members of the ISM Business Survey Committee and publishes monthly diffusion indices related to both the manufacturing and the non-manufacturing sectors; we rely here on the composite reading derived by Haver Analytics (http://www.ism.ws/index.cfm).

Using a simple trend line, we estimate that if the number of firms with fewer than 500 employees had grown in-line with the historical pattern seen from 1977 through 2007, there would have been roughly 600,000 more small businesses in 2012. This measure of "missing" small businesses is nearly five times the largest prior gap of 130,000 seen in 1982. Historically, small businesses have employed an average of 10 people on a weighted basis. This suggests that the shortfall of roughly 600,000 small businesses might account for about six million associated small business jobs in 2012, although it is unclear whether these jobs were truly lost, since some might have shifted to large businesses.

Exhibit 5: The number of small firms declined over the five years from the onset of the crisis
Data available from 1977 to 2012

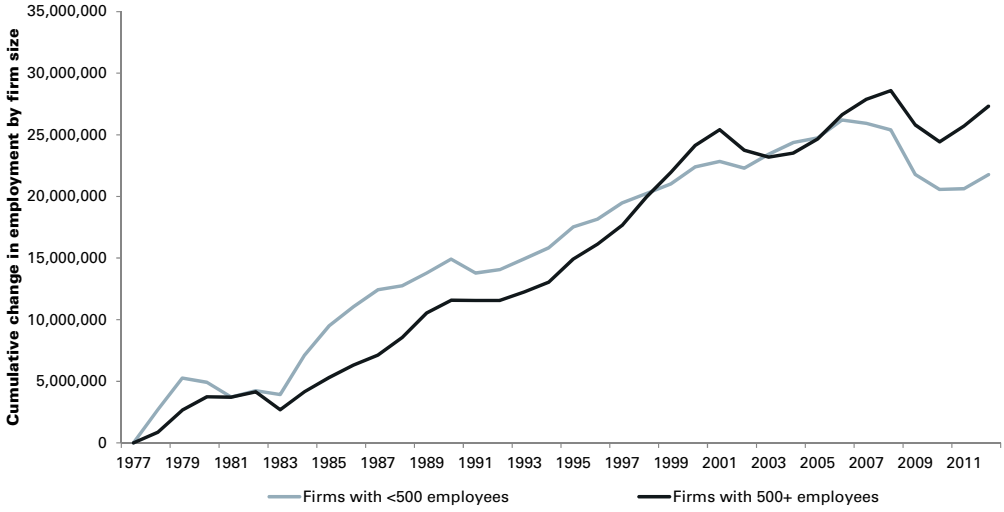


Source: US Census Bureau, Goldman Sachs Global Investment Research.

Employment at small firms is lagging substantially

The problems facing small firms can also be seen in the employment data. Exhibit 6 shows US Census Bureau data measuring employment among firms of different sizes between the late 1970s and 2012. The cumulative change in employment at firms with fewer than 500 employees had historically outpaced the comparable figure for larger firms; in recent years this trend has reversed, with the cumulative rise in employment at smaller firms running significantly below the cumulative increase at larger firms.

Exhibit 6: Cumulative change in employment at smaller firms has lagged the comparable figure for larger firms
Data available from 1977 to 2012



Source: US Census Bureau, Goldman Sachs Global Investment Research.

Exhibit 7 uses the same US Census Bureau dataset to show the average monthly change in employment for the four prior recoveries since the early 1980s. Jobs at firms with more than 500 employees grew by roughly 42,000 per month between 2010 and 2012, exceeding the best historical performance over the prior four recoveries. In contrast, jobs at firms with fewer than 500 employees declined by nearly 700 per month over the same timeframe, whereas this figure had grown by roughly 54,000 per month on average over the prior four recoveries.

Exhibit 7: Relative to history, monthly employment at smaller firms during the early years of the recovery has lagged the comparable figure for larger firms
Average monthly change in employment at firms by size; data available from 1977 to 2012

	Small firms (fewer than 500 employees)	Large firms (500 or more employees)
1981-1983	-27,000	-29,000
1983-1985	146,000	32,000
1992-1994	57,000	41,000
2002-2004	42,000	-53,000
2010-2012	-700	42,000
Average of prior four recoveries since the early 1980s	54,000	-2,000

Source: US Census Bureau, Goldman Sachs Global Investment Research.

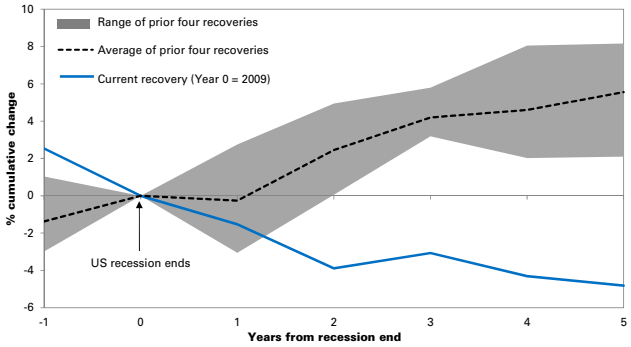
The US Census Bureau data series we examine above is only available through 2012, but it allows us to quantify the relative shift in the share of employment between large and small firms. Other data series – such as small business surveys, the BLS employment dataset and the household employment survey of sole proprietorships – suggest that there has not been a meaningful change in these patterns since 2012. See Appendix B for more detail regarding differences in the BLS and US Census Bureau employment datasets.

Sole proprietorships have also posted a weak recovery

Sole proprietorships, which are not included in the small business data discussed above, play a key role in the economy. These businesses can act as a critical safety valve for unemployed workers. Given the severity of the recent recession, growth in this category should have been strong – but here too the data show that the recovery has been notably weak.

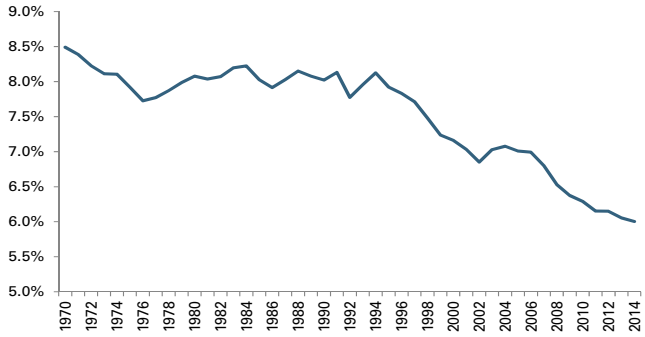
The US Census Bureau counted nearly 23 million sole proprietorships in 2012, reflecting an increase of just 5% since the end of the recession; this is a fraction of the 15% increase over the comparable timeframe during the 2001 recovery. A longer-running and more frequently reported dataset from the BLS that tracks unincorporated self-employed workers (a subset of sole proprietorships) shows that growth in this category has run below even the low end of the historical experience since 1980: the number of unincorporated self-employed workers declined by 150,000 between 2010 and 2012, with a further decline of more than 170,000 during the subsequent two years. This equates to a total reduction in unincorporated self-employed workers of 3% between 2010 and 2014. See Exhibits 8 and 9.

Exhibit 8: Growth in unincorporated self-employed workers has been well below the historical post-recession trend
Reflects recoveries between 1980 and 2014



Source: BLS Current Population Survey, Goldman Sachs Global Investment Research.

Exhibit 9: Unincorporated self-employed workers are a shrinking part of the labor force
Self-employed workers as a proportion of the total civilian labor force

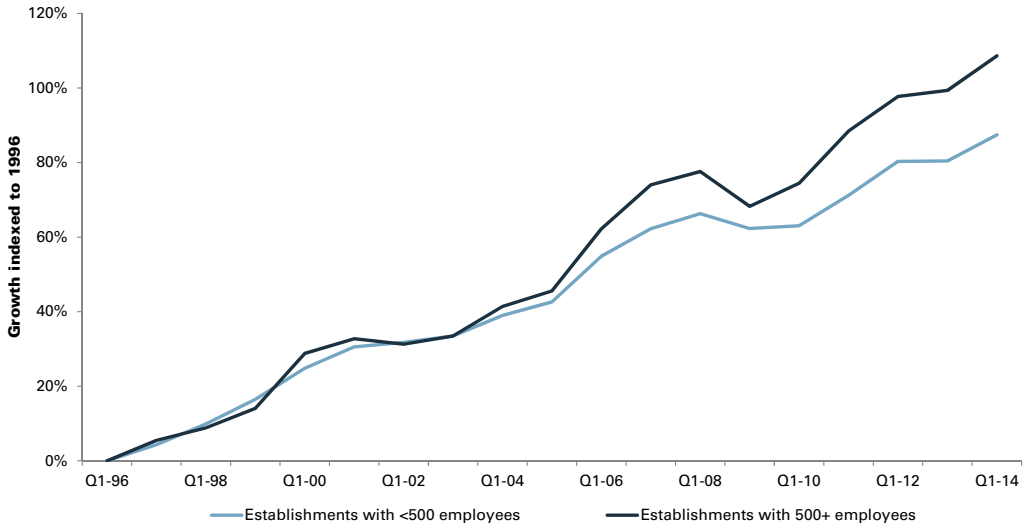


Source: BLS Current Population Survey, Goldman Sachs Global Investment Research.

Wage growth lags at small establishments

The wage data also highlight the divergent positions of small and large establishments.[8] Indexed to 1996 levels, wage growth at establishments with more than 500 employees outpaced wage growth at smaller establishments by a cumulative six percentage points during the 14 years from 1996 through 2009.[9] However, over the subsequent five years, the gap expanded by an additional 14 percentage points, more than twice the divergence seen from 1996 through 2009 in fewer than half as many years.[10] See Exhibit 10.

Exhibit 10: Wage growth at large establishments has outpaced wage growth at small establishments
Average weekly wages in the first quarter of each year, indexed to 1996



Source: BLS, Goldman Sachs Global Investment Research.

[8] While a single business can have more than one establishment (which can be thought of as a storefront), small firms typically have just one.

[9] Wages include bonuses, stock options, severance pay, profit distributions, cash value of meals and lodging, tips and other gratuities, and, in some states, employer contributions to certain deferred compensation plans such as 401(k) plans.

[10] Although the data begin in 1990, our analysis begins in 1996 because of a reporting anomaly in 1995. See Appendix B for the full time-series.

III. Assessing the impact of regulation on small firms

While there will likely always be debate about the complex and lingering nature of the effects of the crisis, perhaps the most plausible explanation for the post-crisis bifurcation between large and small firms is the cumulative impact of new regulations, for two principal reasons.

First, by increasing capital requirements and imposing other restrictions on banks, new regulations have effectively increased the cost and reduced the availability of credit for small firms, which lack alternative sources of finance.

Second, by tightening regulatory requirements across the broader economy (not just for banks), new regulations have raised the fixed cost of doing business. This is a hardship for all firms, and it is not clear whether these regulations can fully account for the bifurcation we see between small and large firms. Nonetheless, these non-bank regulations are particularly challenging for the smaller firms that lack a sufficiently large revenue base over which to amortize these higher fixed costs.

Small firms are hurt most by higher bank borrowing costs

Heightened regulation since the crisis has succeeded in increasing the safety and soundness of the banking system. But, as we discussed in our June 2014 paper, "*Who pays for bank regulation?*", new regulations have also effectively acted as a "tax" on banks, changing the relative prices of different activities, making some activities more expensive and others cheaper. The impact across bank customers is uneven: those customers who can find less expensive sources of financing turn to them, while those without alternatives are forced to bear the higher costs of the taxed activities or are unable to access credit.

In our earlier paper, we reviewed the new regulatory landscape across a broad range of lending markets and looked at changes in lending rates, measured against a 2000-2007 pre-crisis baseline. We found the impact of new regulation to be striking: the markets most exposed to regulatory change, and in which there are few alternative providers of financing, have seen lending rates rise most significantly, while the markets least exposed – or where strong non-bank finance alternatives exist – have actually seen lending spreads fall from the pre-crisis period. See Exhibit 11.

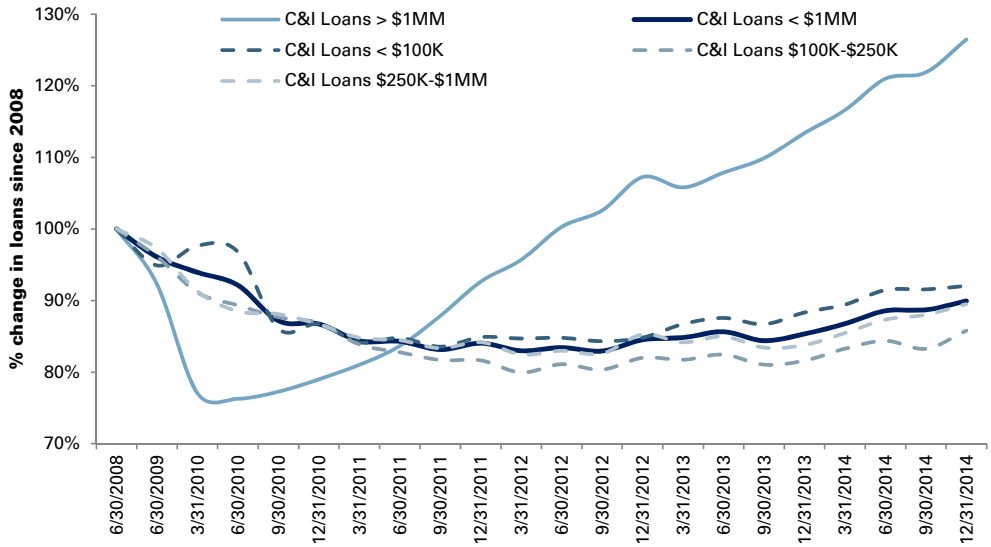
Exhibit 11: Lending rates have been affected by post-crisis banking regulation
Prevailing lending rates, expressed as spreads over applicable benchmarks

Forms of lending	Price (spread over applicable pricing benchmark)			
Loan/ borrower type	2000-2007	2008-2010	2014	14 vs. pre-'08
Credit card	10.6%	13.2%	13.1%	249 bp
Higher FICO	9.6%	10.8%	11.6%	200 bp
Lower FICO	10.3%	13.3%	13.1%	281 bp
Residential mortgage	--	--	--	--
Jumbo	1.7%	3.0%	2.0%	29 bp
Conforming	1.7%	1.9%	1.8%	9 bp
FHA/ VA	1.8%	2.1%	1.5%	-31 bp
Subprime	--	--	--	--
Home equity	2.7%	4.5%	3.4%	65 bp
Commercial real estate	--	--	--	--
Class A (higher-credit)	--	--	--	--
Class B (mid-credit)	1.7%	2.6%	2.1%	47 bp
Smaller CRE	--	--	--	--
Commercial & industrial	--	--	--	--
Large IG corporates	1.5%	2.7%	1.3%	-23 bp
Large HY corporates	5.5%	9.3%	4.0%	-147 bp
Medium unrated corporate	3.5%	5.6%	4.5%	93 bp
Small unrated corporate	2.4%	3.3%	2.7%	31 bp

Source: Goldman Sachs Global Investment Research. The appropriate benchmarks are the one-year Treasury for credit cards and the 10-year Treasury for residential mortgages, commercial real-estate and home equity loans. C&I lending spreads for corporate borrowing are measured against the 3-month Treasury, though for investment grade (IG) bonds, each bond is measured against the appropriate benchmark Treasury, determined by the bond's maturity date. For high yield (HY), the spread is options-adjusted.

The tax from increased bank regulation falls disproportionately on the smaller businesses that have few alternative sources of finance. We see this in the muted recovery in bank lending to small businesses: outstanding commercial and industrial (C&I) loans for less than $1 million are still well below the peak 2008 level and are only 10% above the trough seen in 2012. In contrast, larger C&I loans outstanding (above $1 million) are more than 25% higher than the peak in 2008, as Exhibit 12 shows. Moreover, the cost of the smallest C&I loans has risen by at least 10% from the pre-crisis average. The evidence suggests that smaller firms continue to borrow from banks – when they can get credit – because they lack effective alternative sources of finance. It also suggests that they are paying notably more for credit today; this weighs on their ability to compete with larger firms and to create new jobs.

Exhibit 12: Lending to small businesses has lagged during the current recovery
C&I loans outstanding (2Q2008 through 4Q2014)



Source: FDIC Quarterly Banking Profile, Goldman Sachs Global Investment Research.

In contrast, since the crisis, the largest firms have built up their cash reserves. Non-financial S&P 500 companies hold roughly $1.4 trillion in aggregate in cash and equivalents on their balance sheets, an increase of approximately 80% from the pre-crisis peak. This makes them less likely to require new external funding.

When large firms do seek external funding, many have access to public debt markets, in which yields are near historical lows. However, it is important to note that public debt issuance itself carries regulatory and compliance obligations, making it too expensive for some firms. Here too size is a key factor in determining whether firms can access the lower borrowing rates that bond markets now offer – and the smallest firms often find these costs too great.

Funding for new businesses has been particularly affected by new regulations. Their very nature as new firms makes it difficult for them to obtain funding in a credit-constrained environment. Typically they rely on bank loans and credit cards, along with savings from friends and family for initial funding.

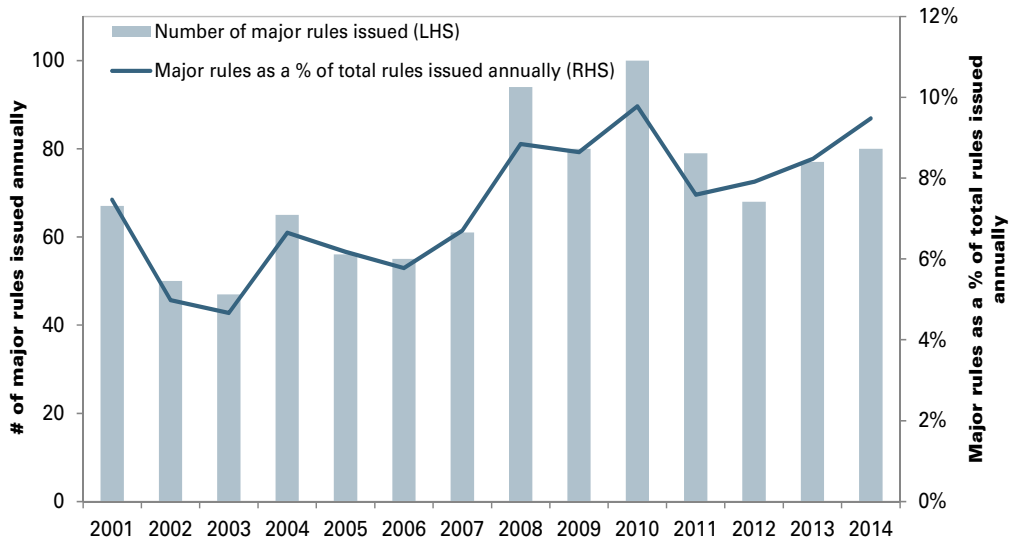
These lending channels have generally been constrained by post-crisis regulations, with higher prices and lower availability of credit. Credit card debt, for example, has been affected not only by stronger bank capital requirements, but also by the Credit CARD Act of 2009 and greater oversight from the Consumer Financial Protection Bureau. Exhibit 11 above illustrates the dynamics of credit card pricing in recent years: rates have risen significantly, with spreads now at least 200 basis points wider than the pre-crisis period, even for prime borrowers. Many would-be borrowers have been priced out of the market entirely: there are nearly 85 million fewer credit card accounts than at the peak in 2008, a reduction of more than 15%.

Regulatory costs create competitive disadvantages for small firms

While we see the new regulations affecting banks as a key driver of the slow and uneven recovery, they are not the only factors. Regulations affecting many other areas of the economy, such as labor and healthcare, have raised the fixed costs of doing business for large and small firms alike – but the competitive consequences differ.

Data from the US Government Accountability Office (GAO) show that the issuance of "major" rules has risen significantly in the wake of the crisis and has remained elevated since then. Roughly 575 major rules were issued at the federal level between 2008 and 2014, some 45% more than the preceding seven-year period, and the share of major rules in the overall total has risen as well. See Exhibit 13.

Exhibit 13: "Major" federal rules issued annually since 2001
A "major rule" costs the US economy $100 million or more annually or results in adverse effects on factors such as competition, investment and employment



Source: GAO, Goldman Sachs Global Investment Research.

Regulation entails costs for both set-up and ongoing compliance. Many of these costs are "fixed," meaning that a firm must bear the cost regardless of its size. The consequences differ for large and small firms. Large firms typically bear far higher total costs, but smaller firms often bear far higher unit costs – meaning a higher cost per employee or per dollar of revenue. For example, the National Association of Manufacturers finds that regulatory costs for companies with fewer than 50 workers are 30% higher per employee than for large firms; in the manufacturing sector, the costs for small firms are more than twice as high per employee.[11]

In effect, higher fixed costs of regulation mean that the government has created economies of scale in regulatory compliance, and that the economically optimal size of a company has generally risen. At a minimum, higher unit costs make small firms less competitive; at worst, they can operate as barriers to entry for new competitors across many sectors.

Exempting smaller firms from regulation would not necessarily help them to compete more effectively in a highly regulated environment. Small firms may be subject to the standards that are imposed on larger firms on a de facto basis, even if not on a de jure basis. This is because regulatory standards for large firms often become the baseline for the industry as a whole, forcing small firms to comply as a precondition for doing business with large firms, regardless of whether small firms are officially covered by the regulation.

This trend is fueled by the growing practice of enforcing regulations via third parties – holding firms responsible for the conduct of their clients, suppliers or distributors. For large firms, particularly consumer-facing ones, the potential reputational and legal risks of dealing with small firms that are subject to less stringent standards may more than outweigh other factors like cost savings or convenience. In effect, small firms may avoid the government paperwork faced by large firms, but they are not always exempted from complying with similar standards, nor can they necessarily avoid the associated costs.

[11] See Crain and Crain, *"The Cost of Federal Regulation to the US Economy, Manufacturing, and Small Business,"* September 2014.

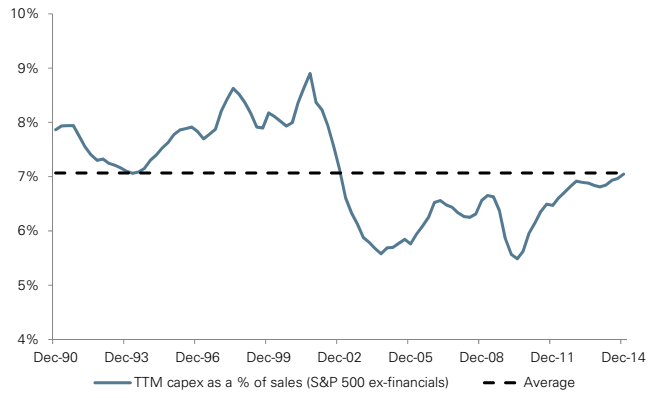
IV. Reduced competition from small firms appears to be affecting the investment decisions of large firms

The impact of the two-speed economy extends beyond the small firms themselves. The competitive disadvantages facing smaller firms appear to be driving larger firms to invest less, and in shorter-term projects, than has historically been the case. This outcome is likely to be to the long-term detriment of the US economy.

Exhibit 14 shows investment in capital expenditures by non-financial S&P 500 companies over the prior 12-month period, measured against revenues. Capital expenditures as a proportion of revenues are only slightly lower than the historical average (by 10 basis points), but this figure is skewed by investments that reflect structural shifts in the energy industry, specifically in shale. After excluding energy, capital expenditures as a percentage of sales are more than 100 basis points below the average since the early 1990s. This figure is particularly surprising given these firms' historically robust net profit margins today.

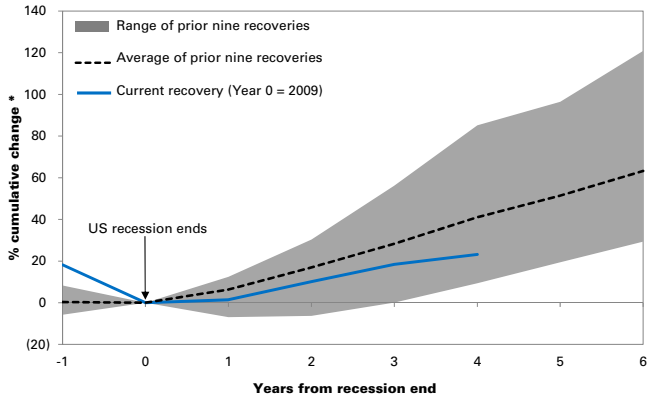
Analysis of a broader dataset suggests that the largest firms are not simply redirecting their funds elsewhere. As Exhibit 15 shows, the recovery in total investment across the US economy – including investment in plants, equipment and intellectual property (but excluding investments in the energy sector)[12] – is considerably weaker than in previous recoveries.

Exhibit 14: Trailing 12-month capital expenditures as a percentage of S&P 500 revenues (excluding financials) are still below trend



Source: Compustat, Goldman Sachs Global Investment Research.

Exhibit 15: Lackluster recovery in private fixed asset investment in the US (excluding oil and gas)
Reflects recoveries between 1954 and 2013

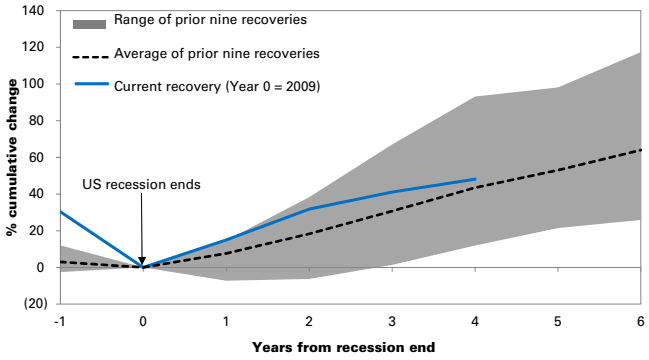


Source: BEA, Goldman Sachs Global Investment Research. (*) Total private fixed asset investment includes plant, equipment and intellectual property.

[12] Private non-residential investment, excluding investments in oil and gas; data based on the Bureau of Economic Analysis' national income and product account data.

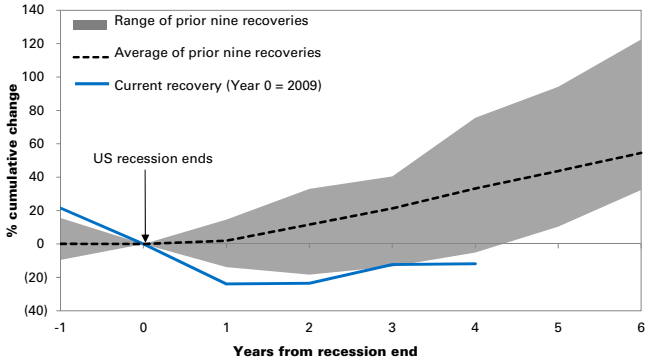
The typical pattern in a slow economic recovery is that firms limit their more cyclical investing, such as investments in equipment, and choose instead to dedicate resources to projects that are designed to benefit from an upturn over the longer term, such as capital-intensive plants. This cycle has bucked that trend. The upturn in equipment investment has been slightly better than the historical average of the prior nine recoveries since the mid-1950s, as Exhibit 16 shows. At the same time, investment in plants has lagged and is trending well below the historical average over the same timeframe (again excluding oil and gas), as Exhibit 17 shows.

Exhibit 16: The current recovery has seen an upturn in private equipment investment (excluding oil and gas)…
Reflects recoveries between 1954 and 2013



Source: BEA, Goldman Sachs Global Investment Research.

Exhibit 17: …while private plant investment (excluding oil and gas) has lagged significantly
Reflects recoveries between 1954 and 2013



Source: BEA, Goldman Sachs Global Investment Research.

What lies behind this atypical bias toward short-term investments (in the form of equipment) and against longer-term investments (in the form of plants)? Regulation may be driving the shift, in an indirect way.

A number of statements from CEOs of major US firms suggest that uncertainty around future regulation may be responsible for the reluctance to invest for the longer term. There also appears to be concern that regulation has become more results-oriented than process-oriented, meaning that if specific regulations fail to produce certain outcomes, they can and will be changed with retroactive effect. The result is lasting operational uncertainty for US businesses, manifested in a change in the time convexity of investment: investment goes to projects that pay off over the short term rather than the long term.

Examples from two sectors help to illustrate this point. First, consider petrochemicals, which are used in everything from plastics to medicines to paint. Petrochemicals are energy-intensive, not only because they are derived from crude oil or natural gas, but also because their production requires energy. As the supply of US shale gas has risen, the cost of producing petrochemicals has declined dramatically, making long-term investments in the sector more attractive economically.

Even so, many long-term investment projects in petrochemicals have been delayed or put on hold, as Exhibit 18 shows.[13] Environmental regulations have existed in the sector for years, suggesting that the current delays do not reflect newly heightened environmental regulatory concerns. A more likely explanation is that these delays reflect uncertainty around the future regulation of natural gas – which is the critical element to attractive long-term investments in the sector.

[13] See Strongin et al, *"Unlocking the Economic Potential of North America's Energy Resources,"* June 2014 (http://www.goldmansachs.com/our-thinking/our-conferences/north-american-energy-summit/unlocking-the-economic-potential-of-north-americas.pdf).

Exhibit 18: Despite favorable economics, many chemicals projects have been delayed
Examples of recent delays to investment projects in the US chemicals industry

Owner	Location	Product	Capacity Addition (kmt/year)	Targeted Start Up Dates: Old	New
Agrium	Midwest	Nitrogen	1000	2017	Indefinite Hold
US Nitrogen	Greeneville, TN	Nitrogen	75	2012	2015
Celanese	Houston, TX	Methanol	1,300	1H2015	4Q2015
Enterprise	Houston, TX	PDH	750	2015	2016
LSB Industries	El Dorado, AR	Nitrogen	375	2015	2016
Valero	New Orleans, LA	Methanol	1,600	2016	2018
Exxon	Houston, TX	Ethylene	1,500	2016	2017
CHS Inc	Spiritwood, ND	Nitrogen	800	2016	2018
Texas Clean Energy Project	Penwall, TX	Nitrogen	475	2015	2019
Ohio Valley Resources	Rockport, IN	Nitrogen	880	2016	2017
Yara	Belle Plaine, SK	Nitrogen	750	2H2016	Indefinite Hold
Hydrogen Energy California	Kern County, CA	Nitrogen	400	2017	2020
Idemitsu Kosan	Freeport, TX	Alpha-Olefins	330	2016	Cancelled

Source: Company reports, media reports, AmmoniaIndustry.com, Goldman Sachs Global Investment Research.

Second, in contrast, consider the US paper industry. Paper manufacturing has been in decline since the early 1990s, reflecting the secular shift of newspapers, magazines and documents to digital format. The secular decline in demand and output was matched by underinvestment (and an aging capital stock) from the early 1990s until the late 2000s. Since then, however, the industry has seen a surprising trend relative to the underlying decline: paper output has risen, due largely to cheaper input costs, in particular shale gas.

As a result, the US has gone from a net importer of paper products over the 2000s to a net exporter since 2009. In fact, the pace of growth in investments in plant, equipment and intellectual property in the paper sector is outpacing the historical trend seen for recoveries since 1960. This likely reflects the rapid payback period associated with paper investments. Even given ongoing regulatory uncertainty, these investments are economically viable because their payback is much quicker than that available in other natural-gas-consuming industries.

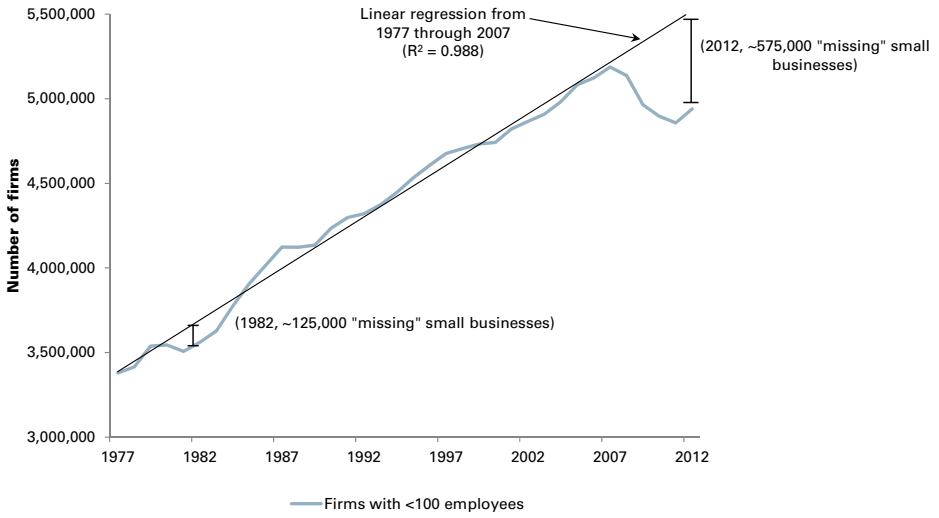
V. Conclusion

While perhaps not on a rule-by-rule basis, in the aggregate the cumulative effects of post-crisis regulations appear to have had a negative impact on the relative competitiveness of small businesses, reshaping the U.S. economy – and likely in ways that were unintended. Each new regulation was not meant to create negative outcomes: each was aimed instead at addressing other policy issues, such as ameliorating the risks of another financial crisis, protecting workers or providing greater access to healthcare. Whether the trade-offs created by the cumulative effects of new regulations are acceptable is both a political question and an economic one, but the issues we observe in this paper should be considered as part of any future evaluation of the aggregate effects of the new rules.

Appendix A: Defining "small" businesses

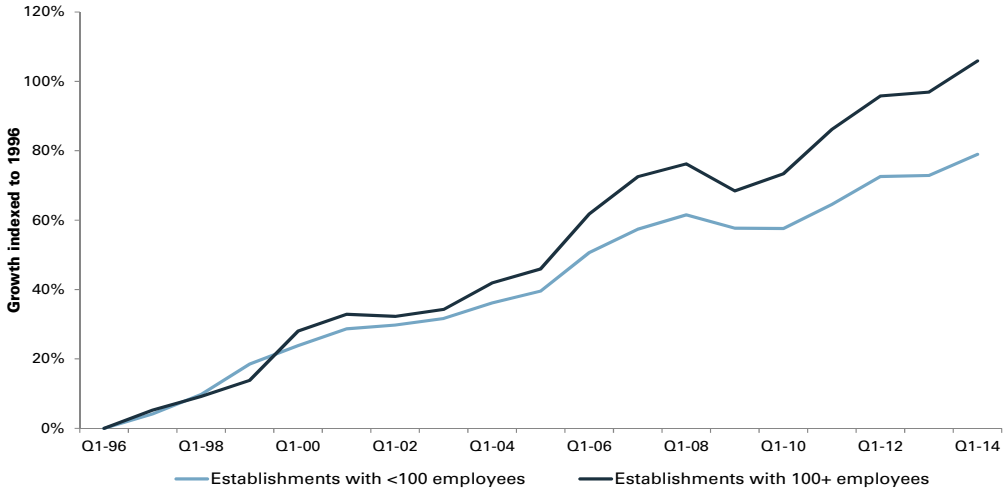
We define "small" businesses throughout this paper as firms or establishments with fewer than 500 employees. As we show in Exhibits 19, 20 and 21, using an alternative definition of "small" businesses – those with fewer than 100 employees – yields similar conclusions to those we observe in the body of the paper.

Exhibit 19: The number of firms with fewer than 100 employees declined over the five years from the onset of the crisis
Data available from 1977 to 2012



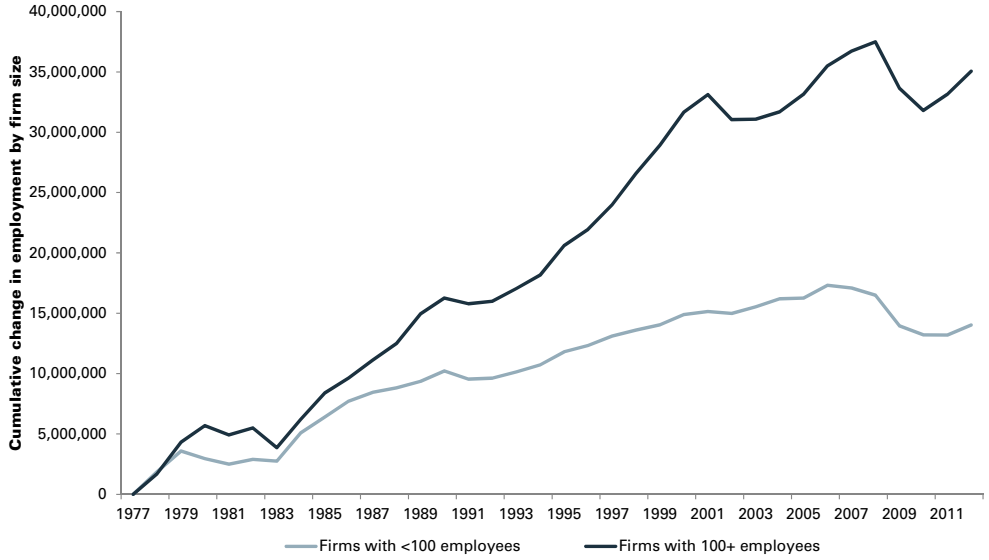
Source: US Census Bureau, Goldman Sachs Global Investment Research.

Exhibit 20: Wage growth at establishments with more than 100 employees has outpaced wage growth at smaller establishments
Average weekly wages in the first quarter of each year, indexed to 1996



Source: BLS, Goldman Sachs Global Investment Research.

Exhibit 21: Cumulative change in employment at firms with fewer than 100 employees has lagged the comparable figure for larger firms
Data available from 1977 through 2012



Source: US Census Bureau, Goldman Sachs Global Investment Research.

Appendix B: Employment figures and wage data

We use the US Census Bureau's Longitudinal Business Database (LBD) in our analysis of firm employment. The LBD is based on a survey of US businesses with paid employees. The data are available annually from 1977 to 2012 (thus providing a long time series but failing to provide data after 2012). The data show the number of firms in operation during each year, classified by number of employees. The LBD uses a "mean-sizing" approach. For example, a firm may have had five employees last year ("t-1") and 25 this year ("t"), or an average of 15 employees between the two years. The firm would thus be classified in the bucket of firms with "10-19" employees this year, from a bucket of "5-9" employees in the prior year.

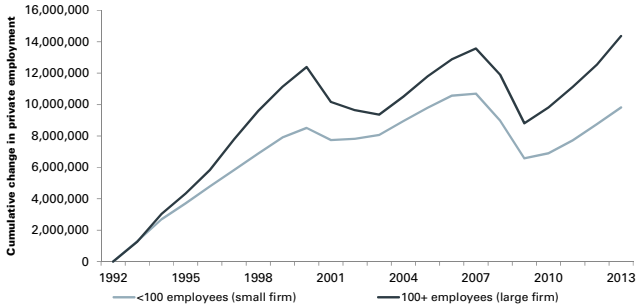
The BLS Business Employment Dynamics (BED) data series is an alternative measure of job growth at small businesses. However, the BLS BED data assess job growth by size class, rather than jobs within a given size class, and thus the data are not directly applicable to the question at hand, namely the relative shift in the share of employment between large and small firms. The BED data are based on a quarterly census of US businesses covered by state unemployment insurance programs. The data are then linked over time to provide a longitudinal history.[14] The BED data are available quarterly from 1993 to 2014 (providing a shorter time series than the LBD but offering more recent data).

The BED relies on a "dynamic-sizing" methodology, which allocates a firm's quarterly employment gain or loss to each respective size class in which the change occurred. Firms are initially assigned to a size class based on their employment in the previous quarter, and over-the-quarter employment changes are distributed to the appropriate size category when a size-class threshold has been crossed. For example, if a firm grows from three employees to 13 employees, the growth of 10 would be allocated as follows: size class 1-4 employees would be credited with the growth of one employee (the growth from three to four), size class 5-9 employees would be credited with the growth of five employees (the growth from four to nine), and size class 10-19 employees would be credited with the growth of four employees (the growth from nine to 13).[15] See Exhibits 22 and 23.

Exhibit 22: Firms with more than 100 employees have added more jobs than small firms since the end of the recent crisis…
Annual data available 1993-2013

Source: BLS, Goldman Sachs Global Investment Research.

Exhibit 23: …contributing to a wider gap in employment relative to history
Cumulative employment on an annual basis since 1992



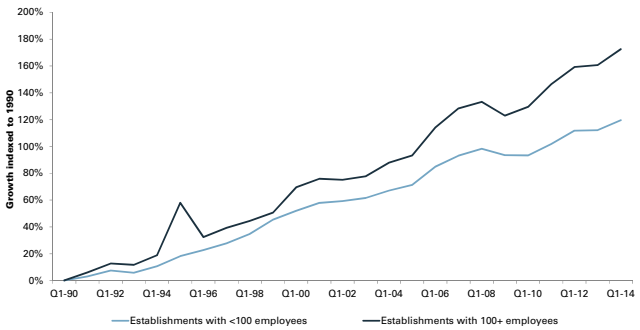
Source: BLS, Goldman Sachs Global Investment Research.

[14] See *"Employment growth by size class: firm and establishment data,"* December 2011, (http://www.bls.gov/opub/mlr/2011/12/art1full.pdf).

[15] See *"Employment dynamics: small and large firms over the business cycle,"* March 2007, (http://www.bls.gov/opub/mlr/2007/03/art3full.pdf).

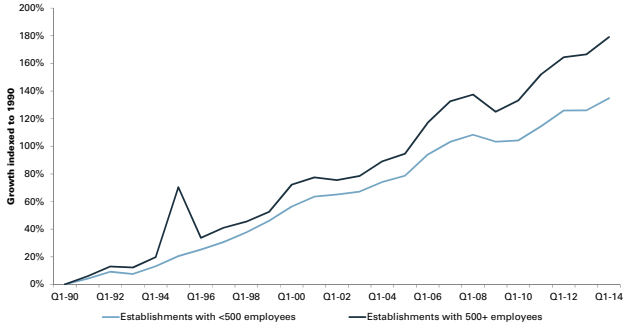
A final note: The wage data referenced in this paper come from the BLS Quarterly Census of Employment and Wages (QCEW). The data are available beginning in 1990; however, we begin our analysis in 1996 due to a significant data anomaly in 1995. Although we cannot be certain, the anomaly may arise because the data were previously reconstructed from an older classification system. As Exhibits 24 and 25 below show, beginning our analysis in 1990 and excluding the anomaly in 1995 yields similar results to those we observe in our prior analysis, again whether we set the threshold for "small" businesses at 100 employees or at 500 employees.[16]

Exhibit 24: Wage growth at establishments with more than 100 employees has outpaced wage growth at smaller establishments during the current recovery
Average weekly wages in the first quarter of each year, indexed to 1990



Source: BLS, Goldman Sachs Global Investment Research.

Exhibit 25: Wage growth at establishments with more than 500 employees has outpaced wage growth at smaller establishments during the current recovery
Average weekly wages in the first quarter of each year, indexed to 1990



Source: BLS, Goldman Sachs Global Investment Research.

[16] See the BLS QCEW for additional detail: http://www.bls.gov/cew/datatoc.htm

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Narrowing the jobs gap

Overcoming impediments to investing in people

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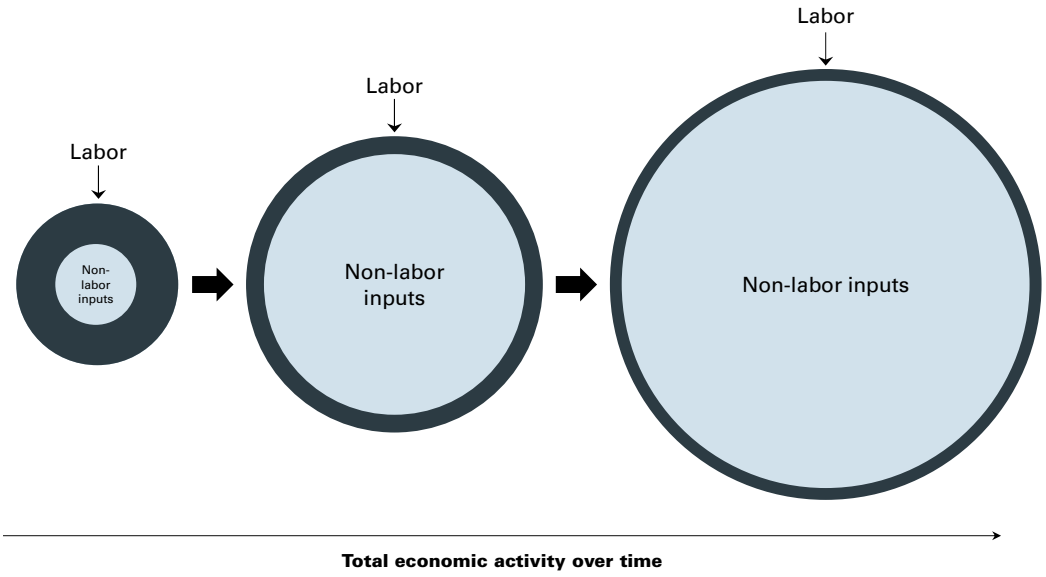
Narrowing the jobs gap: key points

- Although technological change is good for the economy over the long run, it isn't necessarily good for everyone, particularly in the short term. The economy as a whole benefits from the higher living standards that technological innovation generates. But for the people whose jobs are displaced by technology, the macro benefits are of little comfort.
- Occupations and industries follow a natural evolution. Early on, new job opportunities are plentiful and the work is often well-compensated. Over time, jobs become vulnerable to automation, outsourcing or falling wages (or some combination of the three). This process reflects the normal course of economic demand, not any changes in policy. As automation becomes cost-effective, people's economic role shifts from 'doing' the work to 'organizing, coordinating and supervising' the increasingly complex resources and activities behind it. Today, the pace of this evolution is accelerating as measurement technologies and data-collection capabilities improve, putting more jobs at risk.
- The broader economy benefits if more people who are at risk of job displacement retrain and shift to new industries where their competitive advantages over machines offer better long-term economic prospects. But an investment analysis shows that while changing careers makes sense at the macro level, the decision is more complex from an individual's perspective, particularly since she must shoulder the burden of investing in human capital on her own. Often, waiting for even an unlikely job opening in her current occupation can be a superior choice to switching careers, because of the uncertainty involved.
- This dynamic has helped create a 'jobs gap' – the gap that often exists between the types of jobs that people want and the types of jobs that are available. Closing the jobs gap requires a new approach to risk-sharing, one that spreads the burden of investing in human capital more broadly. This risk-sharing approach should include a greater educational focus on social skills, creativity and judgment, not only STEM subjects; expanded incentives for corporate job training; standardized labor contracts; innovative financing structures to support investments in human capital and career transitions; lower barriers to entry into certain professions; increased support for small-business creation; and regulation that supports the growth of the 'freelance economy.'

Exhibit 1: As economic activity expands, technology doesn't eliminate the need for people – it changes their role
Over time, people's principal economic role has evolved from physically 'doing' work to 'organizing, coordinating and supervising' complex resources and activities. As economic activity expands, more people are needed (rather than fewer) to manage the increasing number and sophistication of non-labor inputs



Source: Goldman Sachs Global Investment Research.

I. Narrowing the jobs gap: overcoming impediments to investing in people

Conflict between technological progress and labor dates back centuries. By allowing people to offload tasks to machines, technological innovation eliminates some jobs but also paves the way for new forms of employment and for higher living standards overall. As part of this process, the nature of work evolves; over time, people have shifted from 'doing' physical labor to 'organizing, coordinating, and supervising' increasingly complex resources. In this way, technology has underpinned the innumerable ways in which economic activity has expanded, modernized and become more inclusive and flexible.

The activities that are offloaded to machines tend to be data-intensive, repetitive and standardized – work for which technology and machines are more efficient than people, especially when done at scale. Many occupations (and on a larger scale, many industries) follow a natural evolution. In the early days they are small-scale, innovative, creative and often well-compensated; people dominate. In the later phases these jobs and industries become large-scale, standardized and repetitive and the jobs typically become less remunerative; cost-effective automation displaces people. Given the rapid improvements in measurement and data-collection tools, the pace of these transitions is accelerating and the need to identify how best to deploy – and subsequently redeploy – labor has become more pressing.

While the benefits of technological progress are felt by the economy as a whole over time, this is of little comfort to the individuals whose jobs are displaced by technology (with clear parallels to the impact of globalization). They find themselves in an untenable position as their skills become obsolete, their human capital erodes and their jobs cease to be 'good.' Existing incentives and policies make successful career transitions difficult, particularly for people with significant work experience and above-average earnings. Often, the individual's best economic alternative is to wait and see whether she can find employment that leverages her existing skills – rather than to invest in new employment possibilities – even if finding a new job in her current industry is highly unlikely.

An investment analysis uncovers the economics driving the decisions of whether, and how, to make the investments in human capital that will narrow the 'jobs gap.' This is the gap that often exists between the types of jobs that people want and the types of jobs that are available. The economy in the aggregate benefits if the individuals who are at risk of being displaced by technological innovation move to industries with better long-term prospects. Yet it can be extremely difficult to make these career transitions successfully and to bridge the 'jobs gap' without external assistance.

Companies' incentives to formally invest in employees' human capital are dampened by the risk that the investments will be one-sided; employees may leave, taking the benefits of their training with them before the company has had a chance to recoup the expense. As a result, the burden of investing in human capital falls principally on individuals, who may not be well-placed to bear it.

The economics of these investment decisions point to the public-policy changes needed to narrow the jobs gap, namely by providing greater assistance to individuals and to businesses in order to encourage broad-based investments in human capital. These changes include a greater educational focus on the skills that underpin 'adaptive' occupations, changes to labor contracts, expanded incentives to encourage private-sector investment in job training, innovative financing structures to support the potentially costly process of career transitions and support for small businesses and the freelance economy. In effect, a new approach to risk-sharing is needed.

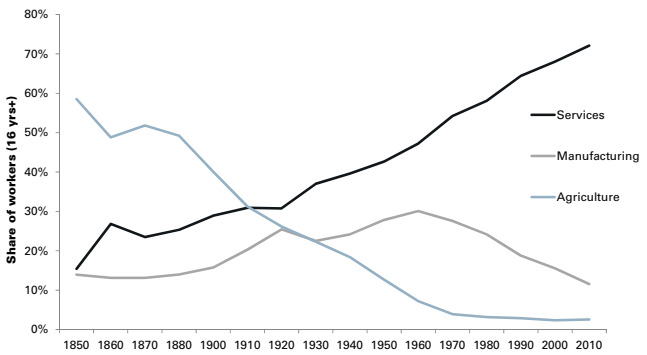
II. Why technological progress can hurt today's jobs even as it benefits the economy's future

Today's rapid spread of technology is only the latest phase in a long historical story that has played out in the US (and elsewhere) many times before. In the 19th century, new agricultural technology vastly increased farming productivity and output, reducing the need for agricultural labor and capital. These surplus resources were reallocated to the burgeoning manufacturing sector beginning in the late 19th century and extending into the mid-20th century. Subsequent innovations in machine-production processes led to a boom in manufacturing that again reduced the need for labor and capital, freeing up the resources that drove the later 20th-century information revolution. Productivity gains from that information revolution have in turn paved the way for the current era of the web, big data and machine learning.

These historical transformations share common features. Initially, the industry that lay at the center of innovation drew inflows of capital and labor, supporting high-profile investments and disruptors and seeming to promise vast opportunities and the extensive creation of high-paying jobs. Productivity rose, making the goods these sectors produced cheaper and more abundant and transforming expensive luxuries into affordable everyday items. But at the same time, higher productivity also reduced the need for labor and the returns to capital in that sector, encouraging both to move elsewhere. Perhaps counter-intuitively, on a relative basis, the sector that was once at the forefront of technological innovation ultimately employed fewer people, required less capital and consumed a smaller share of total spending. The reallocation of excess capital and labor to other sectors, where lower initial levels of productivity created opportunities for higher returns, started the cycle again.

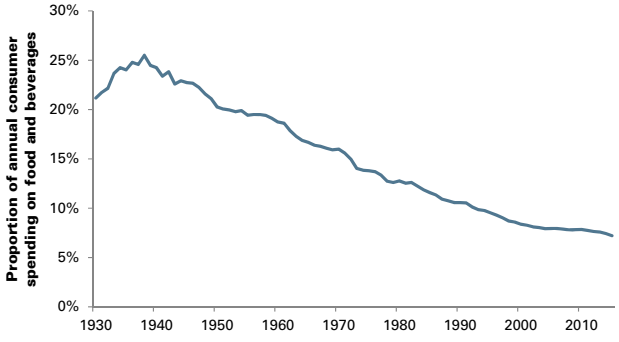
This shift from novel to unremarkable makes economic sense. Today, agriculture employs just 2% of the American workforce, down from 80% in the early 19th century, while manufacturing employment has fallen to roughly 10% today from a peak of nearly 30% in 1960. See Exhibit 2. Spending patterns have changed: food accounts for less than 10% of consumer spending today, down from nearly 25% just 80 years ago, as Exhibit 3 shows. Appendix A tracks these economic transformations in more detail.

Exhibit 2: The share of labor in both agriculture and manufacturing has declined over time, while the share of labor in services has increased
Share of workers aged 16+ in labor force



Source: IPUMS-USA, University of Minnesota, www.ipums.org, Goldman Sachs Global Investment Research. Note: data are not available for 1890.

Exhibit 3: Food has accounted for a decreasing proportion of consumer spending over time
Share of annual consumer spending on food and drink

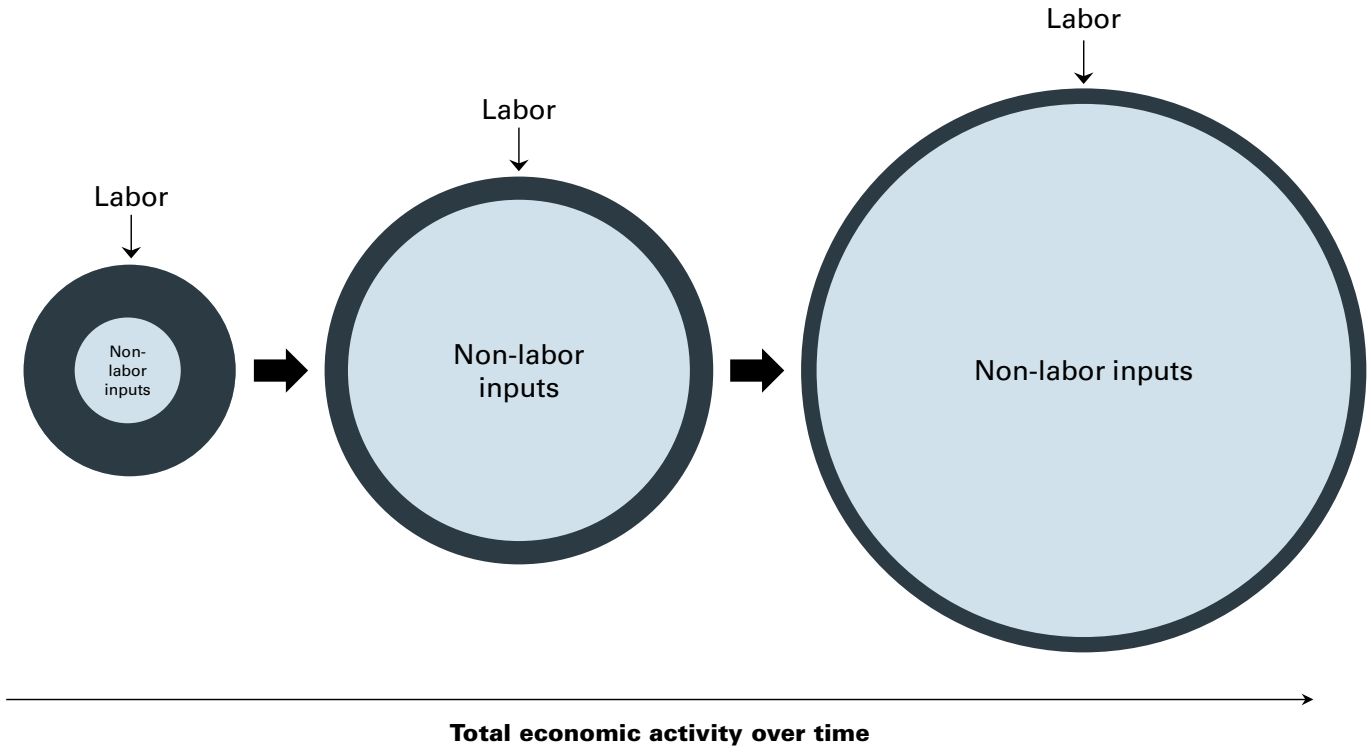


Source: Bureau of Economic Analysis, Goldman Sachs Global Investment Research.

From doing to organizing

Exhibit 4 illustrates the evolution of economic activity over a very long time frame. Economic activity has never been only about people. 'Non-labor inputs' have been important since the hunter-gatherer age, beginning with plants and animals, moving through tools and machinery and extending to the network connectivity of today. Starting at a point in the past when the scope of labor inputs was roughly equivalent to that of non-labor inputs, people spent as much time 'doing' physical work as they did 'coordinating' non-labor inputs (the far-left circle below). Over time, as non-labor inputs have become more numerous and increasingly sophisticated, they have dramatically broadened the scope of what a single person can accomplish and have expanded the universe of economic activity (or total production, often approximated today by GDP) (as shown in the far-right circle below).

Exhibit 4: As economic activity expands, technology doesn't eliminate the need for people – it changes their role
Over time, people's principal economic role has evolved from physically 'doing' work to 'organizing, coordinating and supervising' complex resources and activities. As economic activity expands, more people are needed (rather than fewer) to manage the increasing number and sophistication of non-labor inputs



Source: Goldman Sachs Global Investment Research.

At first glance – and particularly from the perspective of a person whose job has been threatened by or lost to automation – this illustration may suggest that technology is pushing people to the fringes and ultimately eliminating them from the world of work entirely. But the reality is that people remain critical to economic activity: the key is that the nature of 'work' has changed over time as the ratio of non-labor to labor inputs has shifted.[1]

[1] See for example, Katz and Margo, *"Technical change and the relative demand for skilled labor: the United States in historical perspective,"* 2013.

Technology reduces the scope of work that involves heavy physical labor, dangerous machinery and tedious repetition. This pushes people into new roles: organizing, structuring and bringing their problem-solving skills to bear on the ever-growing realm of non-labor inputs. Organizing and coordinating rely more on attributes like creativity, judgment and social skills, and less on physical attributes like strength, speed, good eyesight and manual dexterity.

Non-labor inputs don't eliminate people from the economic equation. Instead the existence and sophistication of the non-labor inputs allow people to stretch their capabilities by focusing on organizing and supervising the tools that generate the output.

Consider farming. For centuries the scope of a farmer's activity was limited to what a family could grow, by hand, on a small patch of land. Tools like the steel plow and the grain drill made labor more efficient and allowed farmers to cultivate bigger plots; the work itself became more complex as people were required to master use of the new tools. When machinery entered the mix, farmers could do more: cultivate more land, farm multiple crops in size, install efficient irrigation systems and move beyond subsistence agriculture. Today, thanks to information technology and network connectivity, much of farming can be done remotely.

The same is broadly true in occupations not typically thought of as technology-intensive, such as housekeeping. Technology has not eliminated physical labor, but it has reduced the intensity of such work. Modern machinery and cleaning products have dramatically expanded the productive capacity of housekeepers and have shifted the work away from a complete reliance on heavy physical labor and toward a greater role in 'coordinating' the use of new products.

Or consider the historical development of transport, which initially was all about labor – walking. Non-labor inputs from the horse to the cart to the stagecoach and ultimately the car changed the dynamic, and walkers became riders whose principal role was to direct and control the new mode of transport. Trains and planes went one step further, concentrating the organizational activity in just a few positions (engineers, pilots and controllers); fewer actors can now move many more people.

Replacing yesterday's jobs with today's

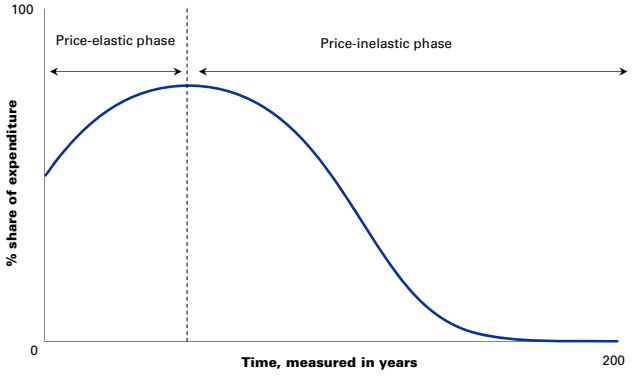
As occupations and industries evolve, they follow what can be thought of as a natural 'arc.' We show this progression in Exhibit 5 and discuss the economics behind it in greater detail in Appendix B.

In the early days of an industry – the price-elastic phase – falling prices result in rapid growth in demand and attract labor and capital. During this period, particularly the early part, there are typically few formal requirements for employment, and wages are above-market in order to compensate for risk and to attract highly motivated and flexible employees. These favorable dynamics are shown as the 'price-elastic phase' of the arc in Exhibit 5.

A dramatically different dynamic begins to unfold as demand growth slows and the industry enters the price-inelastic phase. Productivity now outstrips demand growth, demand for both labor and capital begins to shrink, and jobs become vulnerable to automation, outsourcing or falling wages (or some combination of the three). The wage premium shrinks and the present value of the employment declines. 'Good' jobs lose their luster and, once automation fully sets in, disappear. The jobs that do remain in the industry are less repetitive and more complex; they require employees to continue building job- or industry-specific skills even when the employment outlook for the industry is in structural decline. The inflection in demand and spending is shown as the start of the 'price-inelastic phase' in Exhibit 5, while the accompanying decline in employment is illustrated in Exhibit 6.

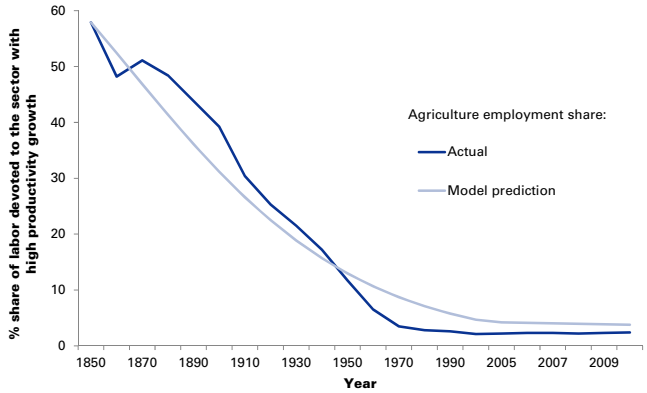
This transformation reflects the normal evolution of demand rather than any changes in policy. No matter what the price, after a certain point greater consumption becomes less fulfilling and often simply impractical. The transition from price-elastic to price-inelastic is typically driven by a combination of broad adoption and natural constraints on greater consumption (such as a 2000-calorie diet or a finite number of leisure hours). Policy can ameliorate some of the impact of this shift, but it cannot change the underlying dynamic. Similarly, trade and globalization may accelerate this process, but they are not the underlying causes.

Exhibit 5: The natural 'arc' of an occupation or industry
In the price-elastic phase, the sector attracts labor, capital and a larger proportion of spending, but these decline in the price-inelastic phase. See Appendix B



Source: Goldman Sachs Global Investment Research.

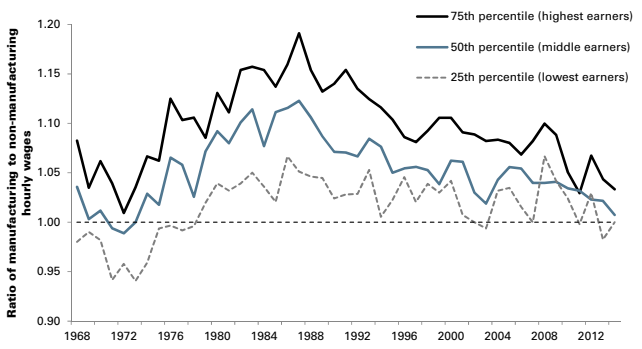
Exhibit 6: Higher US agricultural productivity ultimately led to inelastic demand and fewer labor inputs
See Appendix B



Source: Goldman Sachs Global Investment Research.

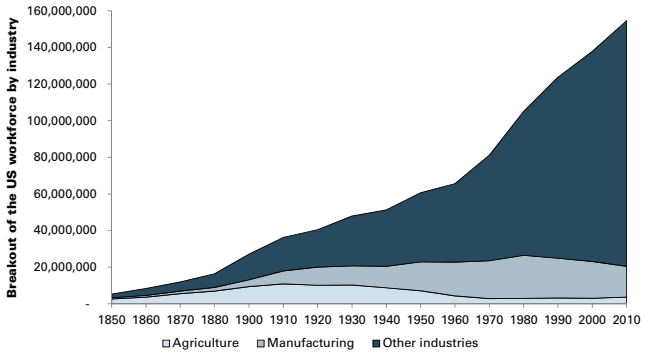
This change in dynamic drives the public narrative that technology is eliminating 'good' jobs, namely the well-paying manufacturing jobs that characterized the US economy from the 1950s through the 1970s (with the impact of automation intensified by trade and globalization). When US manufacturing was on an upswing, those jobs promised long careers with good wages and steady pensions. But the very fact that those jobs consisted of repetitive and standardized tasks, done at scale, made them inherently susceptible to automation, outsourcing or lower wages. Today, these jobs are not as 'good' as they once were: for decades, manufacturing jobs enjoyed a meaningful wage premium to non-manufacturing jobs, but this differential has all but disappeared in recent years, as Exhibit 7 shows. And there are fewer of them: on an absolute basis, manufacturing has lost nearly 7 million jobs since 1980, even as the labor force has grown by more than 50 million people. See Exhibit 8.

Exhibit 7: The historical wage premium for manufacturing work has all but disappeared
Ratio of manufacturing to non-manufacturing hourly wages, by earner percentiles



Source: IPUMS-CPS, University of Minnesota, www.ipums.org, Goldman Sachs Global Investment Research.

Exhibit 8: Manufacturing employment has shrunk while the labor force has grown
US workforce by industry



Source: IPUMS-USA, University of Minnesota, www.ipums.org, Goldman Sachs Global Investment Research.

Technology doesn't just eliminate jobs – it also creates new ones. In some cases the links are direct: new jobs emerge to support the new technologies themselves and to fuel the new businesses – and even the new industries – that those technologies make possible. As an example: the invention of the automobile in the early 20th century destroyed jobs for carriage-makers and stable-workers, but it also created new jobs, not only in auto manufacturing but also in gas stations, dealerships and car-repair shops. In other cases the link is indirect: technology allows for the creation of jobs in entirely unrelated industries because it frees up excess labor, capital and income that can be put to work elsewhere. This is the story of the transformation of the US economy from one dominated by manufacturing to one dominated by services, which we discuss in more detail in Appendix A.

III. Technology versus individuals in the 21st century

Looking at the evolution of employment over the course of prior technological revolutions illuminates the core of what technology is and what it can do. **Over time, machines have consistently excelled in jobs done at scale – repeated tasks that are capable of accurate measurement, that use standardized components and processes and that are performed in controlled environments in order to produce consistent outcomes.** This hasn't changed. What *has* changed is the scope of activities in which machines can excel and the pace at which such transitions are occurring.

In just the past two decades, tremendous increases in analytics capability, the development of more precise measurement techniques and the emergence of advanced processing capability and near-infinite data-storage capacity have expanded the range of jobs that are susceptible to automation. Machine learning is the most recent example of what happens when simple brute-force pattern recognition is combined with massive databases or with cheap, highly flexible and accurate sensors that can generate vast amounts of data. Perhaps the most remarkable illustration of the pace of change is the self-driving car, which only 15 years ago was still a dream given the context-specific nature of driving and its intense reliance on human judgment. Thanks to technological advancements in sensors, global positioning systems and learning algorithms, which gather and process billions of data points instantaneously, driverless cars are a reality today and in another decade may be the norm.

Yet even as the universe of things that can be measured and automated grows, the inherent limits on technology remain. The key limiting factor on automation is its reliance on data. Data allow for clear and consistent inputs, standard production processes and consistent outcomes. Without data, automation and technology cannot be as effective as a person would be. Despite fears that technology will eliminate employment across the board, automation is actually only well-suited for tasks that meet rigid and limiting characteristics.[2]

The changing nature of work: the rise of adaptive occupations

Given these limits, it is not surprising that we also see growth in 'adaptive occupations,' which require the attributes machines lack. Adaptive occupations respond to and generate the eternal demand for the 'new' – the creation of original content, the identification of previously unmet or unrecognized needs, the unique situation that can't be replicated or that can only be resolved through the application of specialized skills, experience or judgment.

People maintain a competitive advantage in almost all contexts in which repetition and measurement are not central or not even possible. They have a lasting competitive advantage in jobs that require personal attributes like judgment, creativity, problem-solving and the ability to read social cues. They also have a lasting competitive advantage in jobs that involve questions of taste or complex customer preferences, jobs that occur in new or unique settings and jobs that require direct interpersonal interaction. Similarly, people are needed for jobs in which the process and the outcome depend on variable and changing factors, such as the physical and social environment, the degree of customization required and the level of professional expertise needed. In all of these cases, machines don't work as effectively.

Adaptive occupations frequently involve interpersonal interaction or a social aspect; the interaction is most often direct and physical but can also be done remotely. This need for

[2] See Autor, "*Polanyi's paradox and the shape of employment growth,*" 2014.

interpersonal interaction also means that many adaptive jobs can only be done on a small scale. And while most are found in service industries, adaptive occupations can also include small-scale goods production.

Though they generally deal with things more than with people, many traditional trades (such as electricians, carpentry, plumbing, locksmiths and tailors) also fall into the category of adaptive occupations. These trades involve site- and context-specific work and typically require a combination of specialized training, the exercise of professional judgment and interaction with customers. People working in adaptive trades gain professional expertise by doing the same work over and over again, but the work is sufficiently different each time that it can't be automated: every project is unique.

Exhibit 9 highlights some adaptive occupations that the Bureau of Labor Statistics expects to show rapid growth over the coming decade.

Exhibit 9: Adaptive occupations are expected to see robust growth
Selected occupations projected by the BLS to have the fastest growth rates between 2014-2024

Selected occupations projected to have the fastest growth rates	Employment (000s)		Change, 2014-24		Median annual wage, 2015	Typical education needed for entry
	2014A	2024E	Number	Percent		
Total, all occupations	**150,540**	**160,329**	**9,789**	**7%**	**$36,200**	**-**
Physical therapist assistants	79	111	32	41%	$55,170	Associate's degree
Home health aides	914	1,262	348	38%	$21,920	No formal educational credential
Nurse practitioners	127	172	45	35%	$98,190	Master's degree
Physical therapists	211	283	72	34%	$84,020	Doctoral or professional degree
Ambulance drivers and attendants, excl. EMTs	20	26	7	33%	$23,740	High school diploma or equivalent
Physician assistants	94	123	29	30%	$98,180	Master's degree
Operations research analysts	91	119	28	30%	$78,630	Bachelor's degree
Personal financial advisors	249	323	74	30%	$89,160	Bachelor's degree
Interpreters and translators	61	79	18	29%	$44,190	Bachelor's degree
Optometrists	41	52	11	27%	$103,900	Doctoral or professional degree
Web developers	149	188	40	27%	$64,970	Associate's degree
Occupational therapists	115	145	30	27%	$80,150	Master's degree
Personal care aides	1,768	2,227	458	26%	$20,980	No formal educational credential
Phlebotomists	113	141	28	25%	$31,630	Postsecondary nondegree award
Emergency medical technicians and paramedics	241	300	59	24%	$31,980	Postsecondary nondegree award

Source: US Bureau of Labor Statistics, Occupational Employment Statistics program, Goldman Sachs Global Investment Research.

Technology can play a role in many adaptive occupations by automating the routine tasks.[3] In these cases, automation doesn't compete with people. Instead, it allows people to devote more time, energy and resources to the areas where they have a natural competitive advantage over technology, and where they add the most value – the creative or non-routine parts of the job. This is the dynamic illustrated in Exhibit 4, playing out on the smaller scale of a single occupation. As an example, consider how vast data-processing and computing power have changed the job of a litigator. Automating the previously labor-intensive process of discovery opens more time for the higher-skill tasks of strategy, writing and trial advocacy.

Over time, even adaptive occupations can evolve into jobs that can be automated in ways that eliminate the role of individual labor. As we mentioned earlier, the key is data. Once processes are no longer new, and once people have exercised their professional judgment

[3] The benefits from mixing people and machines stem from the distinction between tasks and jobs. Tasks are specific activities; jobs consist of clusters of tasks, meaning that individual tasks can be automated even if whole jobs cannot. See Autor, *"The 'task approach' to labor markets: an overview,"* January 2013.

in similar circumstances thousands of times, data as to what works and what doesn't becomes available. Once data makes standardization possible, then machines and processes can be designed to do the work more quickly, more effectively or more cheaply (or all three). At this point, the individuals who find themselves displaced by automation will fare better if they look for new employment elsewhere, in fields where this level of data doesn't yet exist and where technology is not (yet) able to replace labor.

The pace at which occupations and industries move along this natural arc is accelerating, reflecting the ways in which the scale of business has grown, data collection has become easier and measurement technologies have become cheaper and more flexible. This makes narrowing the jobs gap – redeploying people to new opportunities that are not only more critical to the overall health of the economy but also better for the affected individuals themselves – all the more urgent.

IV. The investment analysis: impediments to investing in people

The impact of technological change can be personal and quite painful. It makes hard-won skills obsolete, diminishes – if not destroys – human capital and often leads to permanently lower income. But at the macro level, technological change is impersonal and beneficial, replacing existing products with newer and cheaper goods that generate higher standards of living and overall prosperity. The net result is positive for the economy as a whole, especially over the long term. But this is of little consolation to the individuals whose jobs have been displaced along the way and who feel that the social contract has failed them even though they have 'played by the rules.'

The problem is that it is difficult for individuals to anticipate when and how the rules will change. Many career paths look predictable and profitable – until suddenly a person realizes that his 'good' job is in a declining industry being transformed by automation, offshoring, falling wages or some combination of the three.

To cope with the increasingly rapid and highly personalized deprecation of their own human capital, individuals will need to find effective ways to retrain and to refresh and redeploy their own skills. The challenge is in finding how to make the economics of this new investment work. It is clearly in the broader interest to make that investment – but under existing incentives, it is often in neither a company's nor a person's own economic interest to do so.

To see the problem from a corporate standpoint, consider a company facing an economically equivalent choice between investing in technology and hiring a person, when the machine and the person have the same direct costs and produce the same output. In this (somewhat artificial) scenario, the company will almost certainly choose to invest in the technology rather than hire and invest in training the person.

There are many reasons why this is the case. The obvious ones are the tax and accounting rules that typically favor investing in capital (machinery) rather than labor (people). Over the longer term, two other factors likely matter more. The fact that technology lends itself to scale more effectively than people do means that an evenly balanced choice today will strongly favor technology as the better decision for the future. And perhaps most important is the fact that the employer's investment in a machine has less payback risk than does an equivalent investment in a person, particularly since people can change employers and take any acquired skills with them.

From the individual's standpoint, the decision whether to retrain is a classic investment problem, involving the nature of human capital. Human capital is effectively a highly concentrated portfolio of non-transferable assets with heavy sunk costs in the form of education, training, licensing and experience.

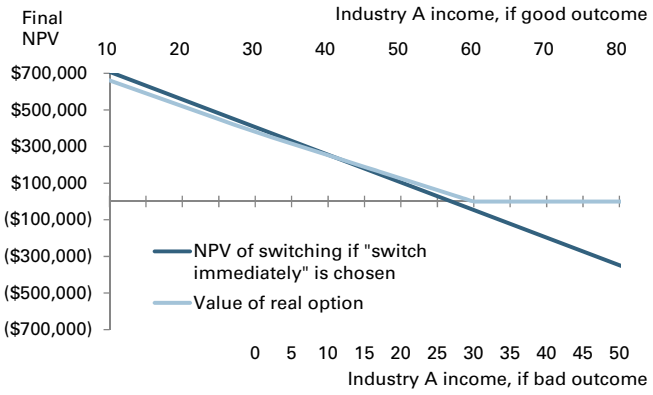
Someone seeking to develop the new human capital needed for success in a different field must write off a significant share of his existing stock. To benefit from the higher expected returns in the new industry, this person will need to recreate all of these investments, which will take time – with no guarantee that his future earnings will match what he earned in the past. Along with the significant uncertainty as to the ultimate returns from the career change, there is also the high likelihood of a reduced income for the foreseeable future, not just during training but also during the early years of the new job. This makes changing careers both expensive and risky, particularly if the person doesn't have external help.

Alternatively, the person at risk of being displaced can wait and hope that an employment opportunity will arise in his current industry, one that allows him to preserve the value of his accumulated human capital. Even industries in decline generate job openings and opportunities as they shrink; for the person on the ground who sees the gross flows of job creation rather than the net number, there is always the chance that one will become available to him. In contrast, there is little chance of returning to his former situation once he leaves his current industry, given how quickly human capital atrophies.

Faced with this choice, the natural inclination is to 'wait and see for now.' As we discuss in much greater detail in Appendix C, the choice to postpone making a decision can be economically rational for *the person*, even though it is a worse outcome for the economy as a whole.[4] Exhibits 10 and 11 illustrate this dynamic for a worker considering shifting to a new industry. Given the magnitude of the loss from changing careers and the fact that a delay will barely affect the net present value of the new occupation (because the choice will still exist in the future), even a small probability that the prospects for his current job will improve can be enough to make delaying a better choice, at least in the near term.

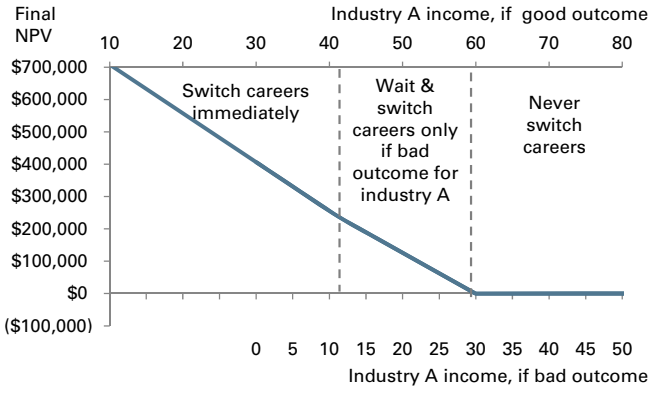
Because 'wait and see' is the easier choice for the person caught between two uncertain outcomes, it makes economic sense to repeat that short delay, time after time. The risk is that 'for now' may become 'forever,' and in the end the person may never make the transition to a new career with a higher net present value.[5]

Exhibit 10: A net present value analysis suggests that a person displaced by technology should opt to change careers immediately . . .
See Appendix C for the NPV analysis



Source: Goldman Sachs Global Investment Research.

Exhibit 11: . . . but this analysis overlooks the fact that the person can wait and postpone making a decision
See Appendix C for the NPV analysis



Source: Goldman Sachs Global Investment Research.

[4] The economic losses associated with job displacement and the value of retraining are well-recognized. But research often overlooks the dislocations that individuals sustain in this process as well as the idea that what might be economically rational for a person may not align with what is best for the economy as a whole. See for example Neal, *"Industry-specific human capital: evidence from displaced workers,"* 1995; Jacobson, LaLonde and Sullivan, *"Is retraining displaced workers a good investment?,"* 2005; O'Leary, *"Policies for displaced workers: an American perspective,"* 2010.

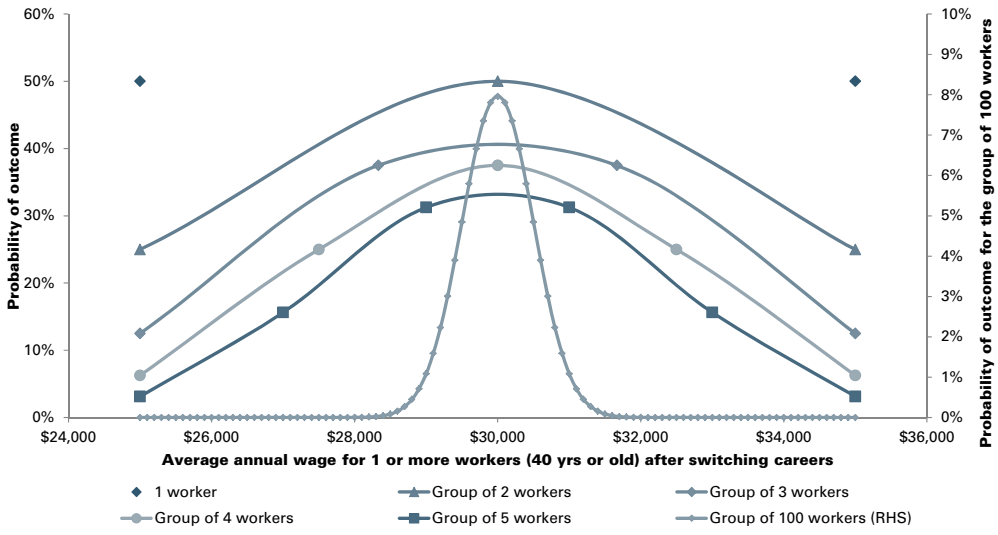
[5] See Jacobson, LaLonde and Sullivan, *"Earnings losses of displaced workers,"* 1993.

The problem is especially acute for more-experienced and higher-skilled individuals. For them, the loss from writing-off existing human capital is larger, the period over which the new investment can pay off is typically shorter and the likely costs of disruption (not only to the person, but also to the person's family) are higher. Thus the *value* of the probability – however small – that this person's prospects in his job will improve makes it far more difficult for well-established and experienced individuals to choose to retrain, reinvest in their human capital or relocate. As we discuss in more detail in Appendix C, the 'wait and see' option may appear particularly attractive for them.

Yet the 'wait and see' approach is not the best answer for the economy as a whole. The aggregate decisions of many individuals to leave their current jobs and retrain for new, more promising occupations – rather than to stay put and wait to make the decision – will benefit the broader economy, generating higher income and a more efficient allocation of capital and labor. This more efficient allocation will support the creation of new jobs. See Exhibit 12, which illustrates how the distribution of average wages narrows as more people leave industries with weak career prospects.

Overcoming the obstacles that prevent people from changing careers can be extremely challenging and will require the greatest changes to existing institutional arrangements.

Exhibit 12: The option value of waiting is high for an individual, but minimal for the broader economy
Distribution of wages changes as the number of people changing careers rises



Source: Goldman Sachs Global Investment Research.

V. The disconnect between individual loss and aggregate gain creates policy challenges

Our investment analysis points to the need to consider how changes in public, educational and employment policies can improve the likelihood of successful career transitions, reduce the frictions that changing careers generates and put more people on the path to new jobs and higher wages. In effect, this means re-thinking risk-sharing. Spreading the costs and the risks of career transitions makes sense if the view is that the broader economy benefits from the average increase in income for individuals who change occupations or industries, as well as from a higher-skilled labor force and from a labor market that values these skills.

Easing career transitions will require a reassessment of education and job-training, a rethinking of employment from the firm's perspective and the development of innovative financing structures. Other important steps to shift some of the burden of risk away from the individual will include decoupling benefits from employment, removing unnecessary barriers to entry into professions, regulating the 'freelance economy' in ways that do not stifle its growth and reducing the regulatory burden that impedes small-business creation.[6]

Educating tomorrow's workforce today

Today's educational system reflects an outdated paradigm in which young people learn a single trade or skillset, find lifetime employment in a single industry and then retire with a steady pension. But today's labor market – and especially tomorrow's – is more likely to see people shift from one trade or skillset to another, and from one industry to another, for the second or even third phases of their careers.

The conventional view about the relationship between technological change and education is that more students should study STEM subjects (science, technology, engineering and math). While there is generally an understanding that people cannot outrun technology in many fields, the intent is to help them drive the development and application of technology. Because teaching STEM is (largely) scalable, this is also an attractive approach for policymakers looking for easily scalable solutions to employment or education.

But studying math and science – while undoubtedly important – isn't the answer to the question of how individuals will adapt to the new labor market. It's unrealistic to think that everyone wants to or will become a scientist, a coder or a technology developer, despite teachers' best efforts and despite deep investments in STEM education. Nor is it realistic to think that even STEM professions will be protected from automation – and thus protect employees – in the long run. Consider what happened to pioneers in computer programming: programmers with extensive knowledge of COBOL were once highly valued, but newer and simpler languages have since pushed those skills to the fringes.

[6] For a discussion of the challenges facing small businesses, see http://www.goldmansachs.com/our-thinking/public-policy/regulatory-reform/2-speed-economy.html

Because it will take longer for computers to replicate the social skills that underpin interpersonal interactions, preparation for the work of the future requires an emphasis on a different set of skills. Individuals will get ahead based on their judgment, critical thinking, creativity and abilities to interpret fluid situations and interact with others. To prepare students for this world of work, education will need to stress 'foundational middle skills'[7] – not just literacy and numeracy, but also adaptability, problem-solving, common sense and team-building skills. This is less a question of curriculum per se but more a question of how subjects are taught – how interactive they are, how much the problems reflect 'real life,' how much teamwork is required and how team dynamics are assessed. Making resilience training a formal part of education may also bolster people's ability to adapt to rapidly changing labor markets in the future.

Community colleges have historically been a convenient and affordable option for people seeking postsecondary education. But these institutions have come under pressure in recent years – with public funding cuts, higher tuition, decreasing enrollment and completion rates well below 50%[8] – and there is room to improve upon the traditional structure, which has typically included a mix of developmental education and job-training curriculum. Reorienting community-college programs to focus more on apprenticeships and other forms of job training, and offering direct paths to jobs at local businesses upon completion, would be a practical way to leverage existing infrastructure to support investments in human capital.

Rethinking risk for both employees and employers

The incentives that exist today make it difficult for private-sector employers – from large companies down to the smallest firms – to make meaningful investments in human capital. The key problem lies in companies' inability to guarantee a reasonable return on their investments. Some skills are firm-specific, but for the most part human capital is fungible – and increasingly so as a facility with technology generates skills that can be transferred across businesses and even industries.

An employer choosing to invest in formal training faces the risk that an employee will leave the firm, taking her skills and knowledge (potentially to a competitor) before the employer has had a chance to recoup the expense. In contrast, companies investing in technology face no such risk. Machines can break, or turn out faulty products, but there is no risk that they will walk out the door. This can make machines the better investment choice. Businesses face a harsh reality: they have limited funds and must invest selectively – with a focus on achieving reasonable returns – in order to remain competitive and profitable over the long term.

Because of this**, it is clear that companies need support in adjusting the way they approach hiring and training, especially as it relates to people who are switching occupations or industries.** Hiring, especially hiring people in mid-career shifts, must become more economically rational and involve less financial and legal risk for employers than is the case today.

[7] See Autor, *"Why are there still so many jobs? The history and future of workplace automation,"* Summer 2015.

[8] See Bailey and Cho, *"Developmental education in community colleges,"* 2010.

These risks point to the need to expand tax and other incentives for on-the-job and professional training for firms of all sizes. This would be an important shift in US tax policy, which for decades has encouraged investments in physical capital, through such provisions as accelerated depreciation and tax credits for technology. In effect this means that the tax system has worked to accelerate the pace of job destruction. Creating new incentives for investing in human capital would encourage job creation instead. The advantages shouldn't be limited to large corporations, particularly since much of the training for adaptive trades will take place at small firms. Broad tax advantages for training should extend as far as the 2.7 million small businesses that file taxes as S corporations, which make up close to half of all small-employer firms in the US, and to the owners of the 20 million sole proprietorships, given that human capital is acquired across a range of opportunities.

Formal apprenticeship programs can offer people of any age the chance to learn new skills without incurring large amounts of debt or foregoing current income. Research sponsored by the US Labor Department estimates that participants who have successfully completed existing government-overseen apprenticeship programs would earn, on average, an incremental $240,000 over the course of a 36-year career. Expanding the tax credits that are available to offset some of the cost could make these programs more attractive to employers. At the same time, a 'no-fault' trial period of employment would also reduce the risk that a company would be tied to an unsuitable hire.

As existing apprenticeship programs may be lengthy and biased toward younger individuals with less work experience, introducing 'experienced-worker apprenticeship' programs could be particularly helpful for older individuals in transition to second or third careers. Ensuring that they do not forego income while they retrain would reduce the uncertainty around the decision to change careers and would make it more economically attractive to do so quickly.

Apprenticeships may be most appropriate in adaptive trades and other fields where hands-on learning is critical, as well as in fields where licenses are required. Broadening these programs beyond traditional fields like construction, machinery, the electrical industry and cosmetology would seem to make sense (medical residencies and internships offer possible models). Community colleges offer another affordable avenue for apprenticeships or similar programs.

In apprenticeships and other hiring contexts, employees and employers alike could benefit from standardized labor contracts. Under these contracts, which could be tailored for each industry, an employee would commit to a set period of employment in exchange for a certain level of employer-provided training. Both sides would benefit: the employee would have the commitment that she would receive formal or on-the-job training, while the employer could benefit from the greater likelihood of recouping its investment. As examples, contracts might be roughly akin to the agreements in Reserve Officers' Training Corps (ROTC) or the service commitments required when the military pays for medical or law school.

Legal limits to the enforceability of employment commitments mean that these contracts would need to be designed carefully. The employment would be an explicit exchange of the employee's labor for employer-provided training, with the acknowledgment that training can be assigned a monetary value because it deepens and expands the employee's own human capital. Termination provisions allowing the employee to break the contract by reimbursing the firm for the value of receiving this human capital could protect the employee and strengthen the employer's incentives to provide the training. In addition, standardization would lead to greater consistency and predictability for employees, thus reducing employee concern and enhancing the likelihood of compliance.

Developing innovative financing approaches

Retraining and changing careers carries meaningful economic risk. Retraining itself may or may not be expensive, but the opportunity costs can be significant, and wages are likely to be lower in (at least) the first few years of a new occupation. From a financial standpoint, changing jobs is particularly challenging for older people, who are more likely to have commitments that cannot be put on hold, such as home ownership, medical bills or dependents' education expenses.

Allowing people to finance retraining by tapping into private savings that are currently earmarked for retirement – 401(k) funds and IRAs – without penalty is one route. Another is creating separate 'career transition' savings accounts that are tax-advantaged but more easily accessible, without penalty, and that can be used to pay living expenses during retraining.

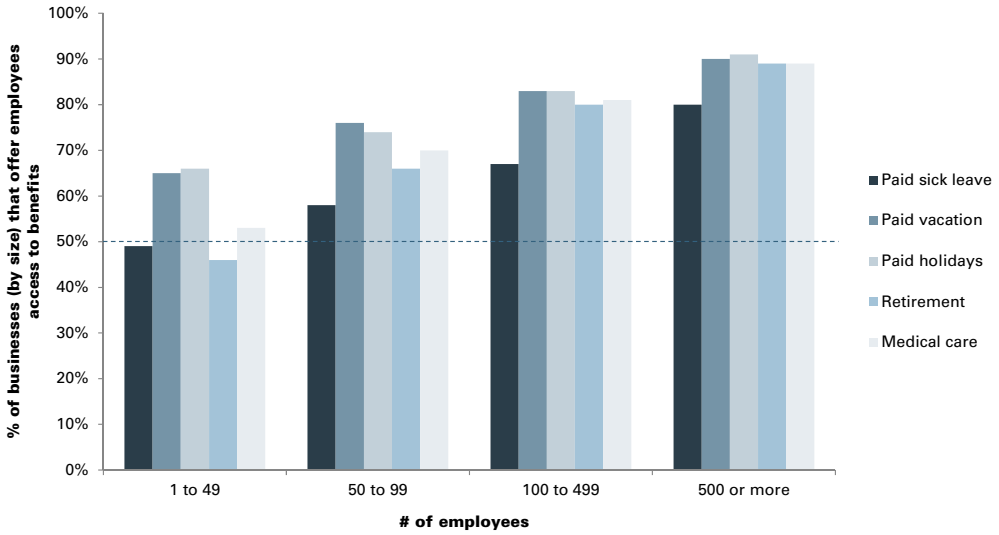
These approaches will not work for everyone, particularly for younger people who have not had time to build a savings cushion. A further option would be to make Social Security funds available to cover the costs of retraining as well as living expenses during a transition period – essentially an advance on future distributions. Because this would have obvious implications for Social Security's long-term funding, such a program might require people who drew down funds in mid-life to increase their contributions later in life or to postpone their retirements (which would also increase the net present value of their new jobs).

Risk-sharing can also be extended to the public financing of higher and vocational education, again on the grounds that a highly skilled workforce is in the common interest. The current structure of the student loan market could benefit from a fundamental review: outstanding student debt is now above $1.3 trillion, and more than seven million people are in default. Student loans offering income-based repayment programs may offer a less onerous and more effective way to finance education without imposing life-long burdens on borrowers. To this end, the federal government has introduced income-based repayment programs for federal student loans with the goal of promoting affordability.[9] Similar incentives could be expanded to support vocational training for younger people and for a broad range of training efforts later in life.

Revising employee-benefits policies would also shift some of the risk and encourage employment regardless of the prospective employee's age or previous work history. Decoupling benefits from employment and making them more portable would improve labor-market flexibility and could make smaller businesses more attractive as employers. Large firms are currently considerably more likely than smaller firms to offer retirement plans, medical care and paid sick leave, as Exhibit 13 shows. Recent data from the Bureau of Labor Statistics indicate that retirement plans are not currently available at more than half of all private businesses that employ fewer than 50 people. While this is in part a matter of cost, it is also a question of accessibility: reducing administrative burdens would make it easier for small firms to offer these benefits.

[9] The 'Pay as You Earn' repayment plan for federal student loans, launched in 2012, caps loan-service payments at 10% of the borrower's annual discretionary income. This plan also offers debt forgiveness of any remaining balance after 10 years for people who work in public service and after 20 years for other borrowers. See also https://www.newyorkfed.org/medialibrary/media/research/staff_reports/sr668.pdf

Exhibit 13: Large firms are more likely to offer employee benefits
Share of establishments (by size) that offer employees access to selected benefits, 2015



Source: US Bureau of Labor Statistics, National Compensation Survey, Goldman Sachs Global Investment Research.

Reducing barriers to entry and supporting the freelance economy

Second and third careers will not necessarily involve jobs at existing firms, particularly large firms. Many people will become self-employed, start their own businesses or join small companies. To support these transitions, entrance into new professions should be made easier, with limits on self-regulatory organizations' ability to create barriers to entry that reduce competition and constrain geographic mobility.

A recent White House report indicates that some 25% of US workers now require a license, a five-fold increase from the early 1950s; two-thirds of the increase reflects a rise in the number of occupations that require a license rather than a rise in the number of people in these jobs. Although more than 1000 occupations are regulated across the country, fewer than 60 are regulated by every state;[10] see Exhibit 14. Licensing costs can be a prohibitive barrier to entry for someone looking to move to a new occupation. For example, a minimum-wage earner in Louisiana who wants to obtain a retail florist license faces up-front costs equivalent to at least a week's wages, with annual license-renewal fees costing a day's pay for even an experienced florist.

[10] See *"Occupational licensing: a framework for policymakers,"* July 2015; https://www.whitehouse.gov/sites/default/files/docs/licensing_report_final_nonembargo.pdf

Exhibit 14: Licensing requirements vary across the country
Selected occupations requiring licenses, licensing fees and median wages

Selected ccupations that require a license	# of states* that require a license	Avg licensing fee (2012)	Median hourly wage (2015)	Median hourly wage vs. the $7.25 federal min wage
Cosmetologist	51	$140	$11.00	1.5X
Truck Driver	51	$80	$19.00	2.6X
Pest Control Applicator	51	$90	$16.00	2.2X
School Bus Driver	51	$100	$14.00	1.9X
Emergency Medical Technician	51	$90	$15.00	2.1X
Barber	50	$130	$12.00	1.7X
Preschool Teacher	49	$100	$22.00	3.0X
Athletic Trainer	46	$440	-	-
Veterinary Technologist	37	$210	$15.00	2.1X
Security Guard	37	$90	$12.00	1.7X
Security Alarm Installer	34	$210	$21.00	2.9X
Auctioneer	33	$310	$15.00	2.1X
Child Care Worker	33	-	$10.00	1.4X
Teacher Assistant	29	$80	-	-
Taxidermist	26	$70	-	-
Gaming Dealer	24	$170	$9.00	1.2X
Animal Trainer	20	$90	$13.00	1.8X
Animal Control Officer	17	$120	$16.00	2.2X
Sign Language Interpreter	16	$770	$21.00	2.9X
Locksmith	13	$150	$19.00	2.6X
Pharmacy Technician	12	$70	$15.00	2.1X
Farm Labor Contractor	9	$160	$15.00	2.1X

Source: Institute for Justice: License to Work: A National Study of Burdens from Occupational Licensing (April 2012), US Bureau of Labor Statistics, Occupational Employment Statistics (May 2015), Goldman Sachs Global Investment Research.
**Note: 'states' includes the District of Columbia.*

Supporting individuals undertaking career transitions also means approaching regulation of the 'freelance economy' in ways that do not impede its growth. The freelance economy is already a crucial safety net for many, including those whose current jobs are being automated away. Offering individuals the opportunity to easily monetize their existing assets and skills – spare rooms, free time, driving licenses, cooking talents – is a particularly good way of offsetting some of the opportunity costs of retraining. Rules around classification of employees and independent contractors, working conditions, pay, benefits, liability and insurance should all be viewed with an eye toward supporting the freelance economy rather than stifling it.

VI. Conclusion

Technological disruption of the labor market has been under way for decades, eliminating some jobs while simultaneously improving living standards and laying the foundation for new occupations and new industries to emerge. Thanks to advancements in measurement technologies and data-collection capabilities, the pace of this disruption is accelerating, and the need to identify how best to deploy labor is becoming more pressing.

Technology-driven change can and should be viewed as an opportunity – not as a relentless threat. But making this opportunity a reality for many people will require a new approach to risk-sharing to reduce the uncertainty that comes with undertaking career transitions. From a public-policy perspective, this will require modernizing education, revisiting the structure of employment and offering greater financial support to individuals and businesses seeking to invest in human capital. We believe that policy changes such as these are critical first steps to closing the jobs gap by better aligning what is economically rational for an individual with what is beneficial for the economy as whole.

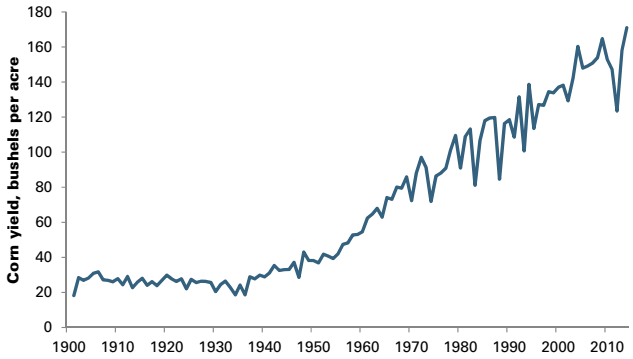
Appendix A: Technological innovation has fueled job destruction and creation throughout American history

Earlier transitions in the US economy offer insights into the way that technology has fundamentally reshaped the labor market. In both the 19th-century shift from farming to manufacturing and the 20th-century information revolution, technology eliminated entire categories of jobs while also driving job growth in new fields and previously unimagined occupations.

At the start of the 19th century, agriculture dominated the US economy, accounting for 80% of total employment and more than half of gross domestic product. Farms were generally individually owned and produced a range of crops on a single plot, largely for personal use or local consumption. Productivity and output were relatively low, and although farming had advanced beyond the subsistence level, it remained labor-intensive, small-scale and fragmented.

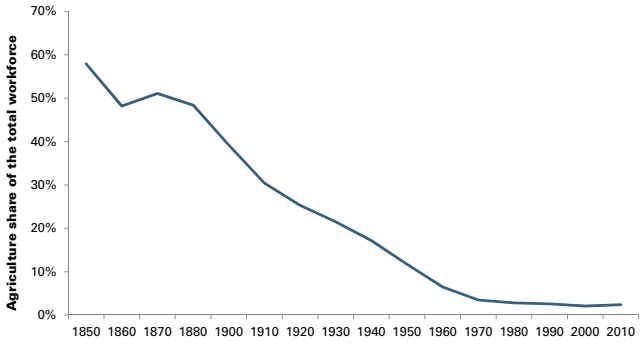
New farming technology introduced from the 1840s, including factory-made agricultural machinery and commercially produced fertilizer, made large-scale commercial farming feasible for the first time. These new tools drove rapid improvements in productivity and accelerated growth in per capita output; though the historical data are limited, Exhibit 15 tracks the improvement in corn yield since 1900. As productivity rose, agriculture's share of total employment declined meaningfully, falling just below 50% by 1880 and to 40% by 1900. By 1950 the proportion of the labor force working in agriculture had dwindled to roughly 10% and, thanks to continuing increases in productivity, today this figure is just 2%. See Exhibit 16.

Exhibit 15: Technology has contributed to higher agricultural yields
Corn yield, bushels/acre



Source: US Department of Agriculture, Goldman Sachs Global Investment Research.

Exhibit 16: Agricultural employment share has declined over time
Agricultural employment share of the labor force



Source: IPUMS-USA, University of Minnesota, www.ipums.org, Goldman Sachs Global Investment Research. Note: Data are not available for 1890.

On the surface, the severe contraction in agricultural employment experienced after 1850 was a negative consequence of technology. However, this technological change allowed the country to move into a new phase of economic growth, in several ways.

First, higher agricultural productivity freed up a large part of the workforce and allowed labor to shift to manufacturing. Manufacturing was a critical source of employment for displaced farmers as well as for new entrants into the labor force (women and immigrants); manufacturing employment rose from roughly 600,000 in 1850 to nearly four million by 1900. While farming generally required specific traits and skills – for example, physical strength and situational experience – large-scale manufacturing processes simplified and deconstructed larger tasks into a series of smaller ones. People could be taught how to perform these bite-sized tasks on the job, thereby developing new and specialized sets of skills.

Second, the rise of mechanized manufacturing in the late 19th and early 20th centuries dramatically improved the quantity and quality of output across a wide range of industries. Consider the shoe industry, where automation has had a dramatic impact on product availability, customer choice and cost. For centuries shoes were fabricated by hand, with little variation or customization except at the highest end; they came in just a few sizes and typically didn't distinguish between right foot and left. In the 19th century, technological advances including the introduction of rolling and sewing machines allowed for faster production and higher output. With greater volume, producers were able to gather enough data to standardize their production to more effectively serve the mass market; they could refine shoe sizes to fit most of the population and could make the production of 'right' and 'left' shoes the norm.

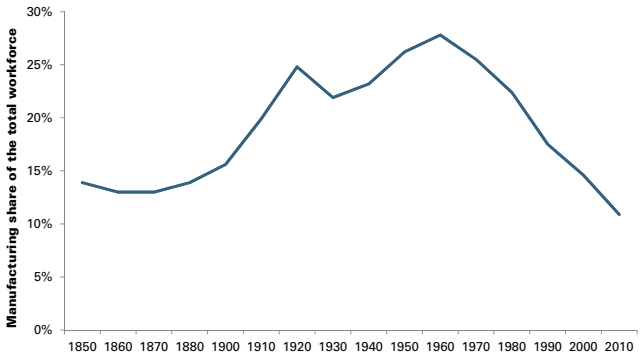
Individual craftsmen undoubtedly felt the pain of this technological transition, and few people train to become cobblers today. The shoe designers who have replaced cobblers bring a different set of skills to the job. Yet consumers have clearly benefited from their inexpensive access to a dazzling array of choices; the average American bought more than seven pairs of shoes in 2013 alone.

This dynamic is also evident in the mechanization of automobile manufacturing. Early automobiles were labor-intensive, highly customized and expensive: in 1900, the more than two dozen automobile manufacturers in the US produced just a few thousand cars in total. Later, the standardization of parts, machine-based manufacturing and assembly-line production made it possible to mass-produce cars that the average American household could afford. The company that pioneered this approach – Ford Motor Company – produced more than one million Model T cars on average each year between 1913 and 1927 while reducing the price by roughly two-thirds.

After the turn of the 20th century, the pace of job growth in manufacturing began to exceed the pace of population growth: the share of the workforce employed in manufacturing jumped from 15% in 1900 to 25% in 1920. By 1960, the sector employed nearly one-third of working Americans.

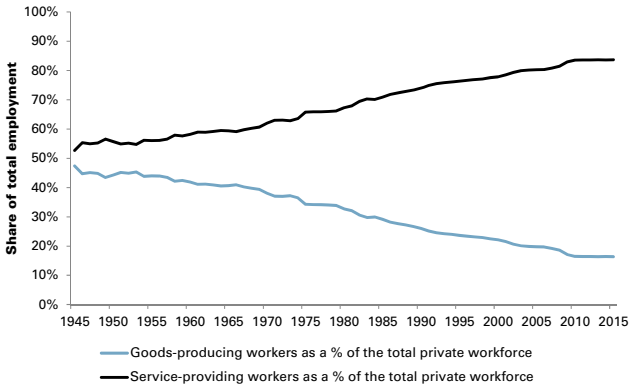
Even so, it wasn't long before further technological innovations caused the industrial revolution to give way to the information revolution and the growing prominence of the services sector. In 1945 half of the private workforce was employed in a goods-producing industry (a category that includes manufacturing). But as post-war capital investment drove meaningful increases in manufacturing productivity, the share of employment engaged in manufacturing began to decline. The labor shift was rapid: between 1945 and the mid-1990s, the goods-producing share of the private labor force fell from roughly 50% to less than 25%, while the services share grew from roughly 50% to just over 75%. Today, the services sector employs 85% of the private workforce, while the share in goods-producing industries is just 15%. See Exhibits 17 and 18.

Exhibit 17: Manufacturing employment share has declined sharply since 1970
Manufacturing employment share of the labor force



Source: IPUMS-USA, University of Minnesota, www.ipums.org, Goldman Sachs Global Investment Research.

Exhibit 18: The share of the workforce producing services has grown rapidly in the post-war period
Services vs. goods-producing employment share



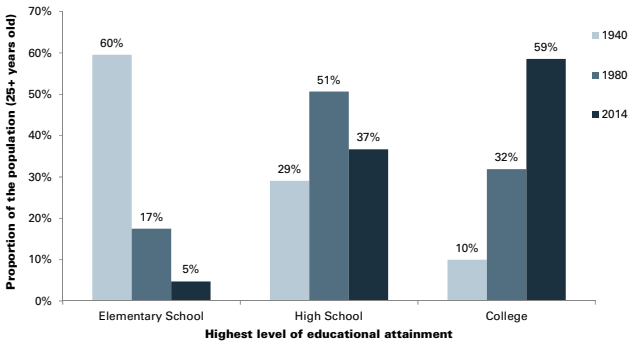
Source: US Bureau of Labor Statistics, Goldman Sachs Global Investment Research.

This shift away from manufacturing and into services took place amid, and drove, a rise in overall educational levels. In 1940, just 10% of the adult workforce had completed at least one year of college, and more than half hadn't made it past primary school. By 1980, when manufacturing employment peaked, nearly one-third of the adult workforce had completed at least one year of college, and only 15% of the workforce had finished their education at primary school. Today, roughly 60% of the adult civilian population has completed at least one year of college, while just 5% finished their formal education at primary school. See Exhibit 19.

The latest Bureau of Labor Statistics employment-projection data suggest that six of the ten occupations expected to show the fastest job growth by 2024 require at least an associate's degree; all ten of the occupations expected to pay the highest wages require at least a bachelor's degree as well as some form of on-the-job training as a requirement to achieve competency. The importance of formal education continues to rise: for nearly the past 25 years, unemployment rates have been highest among adults who have not graduated from high school and lowest among college graduates.

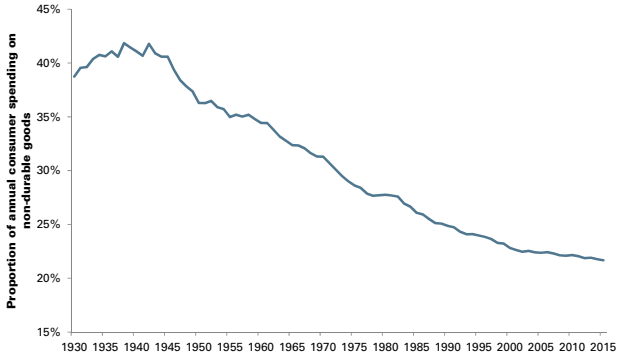
Ultimately, automation has continuously placed downward pressure on the prices of manufactured goods, raising living standards and freeing up consumer spending power to be redeployed elsewhere, in sectors that themselves have created new employment. In 1930, nearly 40% of consumer spending was dedicated to non-durable goods like clothing, shoes and gas. Today, the relative economic importance of these items to the consumer has tumbled: spending on them has been nearly halved, freeing up resources to be spent on durable goods (housing, cars) and services (education, health care, entertainment) – and creating new jobs in the process of supplying these new needs. See Exhibit 20.

Exhibit 19: Educational levels have risen over time
Civilian population by highest level of educational attainment, snapshots of 1940 vs. 1980 vs. 2014



Source: US Census Bureau, Goldman Sachs Global Investment Research.
Note: 'elementary school' includes people who with no formal schooling and those who attended school for up to 8 years; 'high school' includes people who finished elementary school and attended high school for any period of time; 'college' includes people who finished high school and attended college for any period of time.

Exhibit 20: Technology and productivity gains have driven down consumer spending on non-durable goods
Proportion of annual consumer spending on non-durable goods



Source: Bureau of Economic Analysis, Goldman Sachs Global Investment Research.

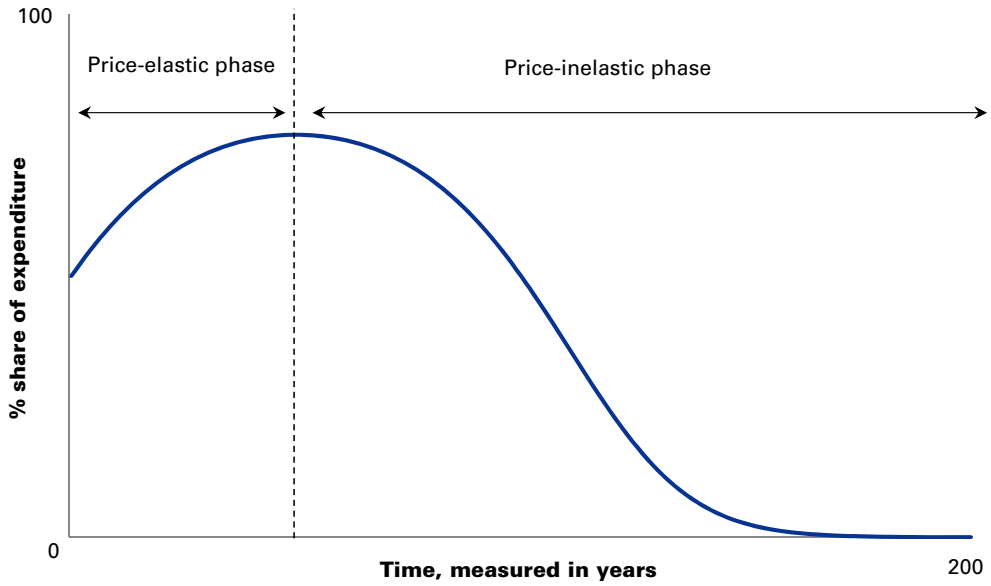
Appendix B: The natural 'arc' of occupations and industries

There are typically two distinct narratives about the interaction of technology with industries or jobs. The first relates to the promise of new technology as a focal point for investment, offering unlimited employment opportunity and the potential to create social good. The second, more draconian take, sees technology as the relentless destroyer of 'good' jobs.

In practice, occupations and industries tend to follow a predictable arc that ultimately encompasses both narratives.[11] The early phases are characterized by enthusiasm and discovery: jobs are loosely defined and the necessary credentials have not yet been specified or perhaps even invented. From a consumption standpoint, price elasticities tend to be high, meaning that every one percentage point drop in price created by better productivity – reflecting advancements in technology – generates more than one percentage point of demand. As a result, the market grows, as does the need for new capital and more employees.

These dynamics are depicted in Exhibit 21, which illustrates how the share of spending dedicated to goods in a sector that is experiencing fast productivity growth increases when prices are elastic– the early stages of the arc – and declines in the later stages, when prices are inelastic.

Exhibit 21: The natural 'arc' of an occupation or industry
In its early phases, the sector at the center of innovation attracts labor and capital and captures a large proportion of spending. Over time, it requires less labor and capital and captures a smaller proportion of spending



Source: Goldman Sachs Global Investment Research.

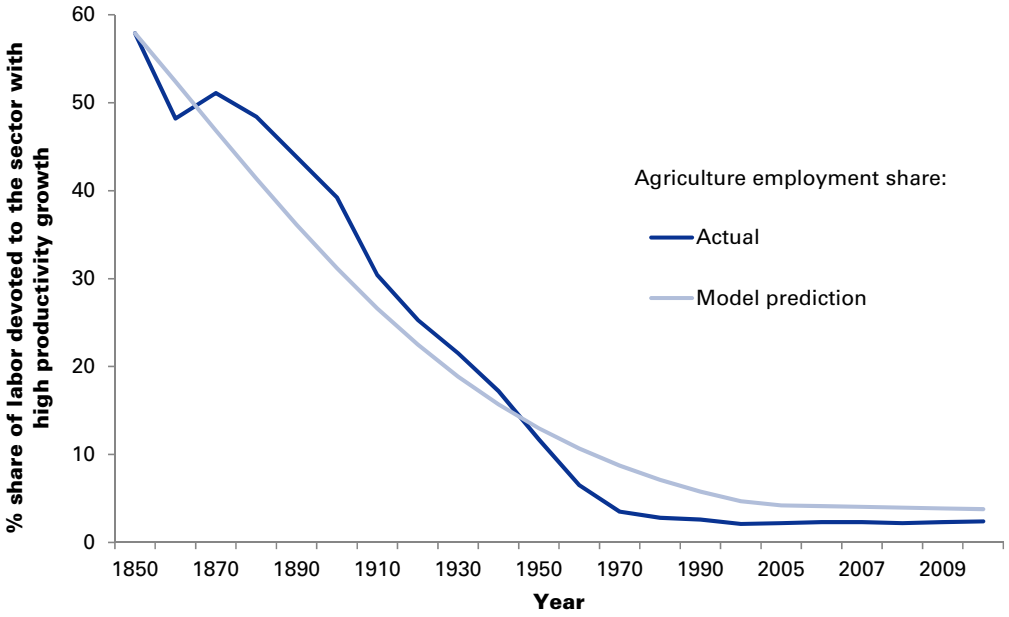
[11] See Jacobson, LaLonde and Sullivan, *"Long-term earnings losses of high-seniority displaced workers,"* November 1993.

An extrapolation of the early phases of the arc suggests that the new occupation or industry will continue to offer unlimited growth and employment opportunities. Unfortunately, the early phases cannot last. As history has shown, in the end all industries (at least so far) hit a limit in demand as the value of the technology that underpins them is pushed to its limits. As a recent example: the promise of unlimited media streaming is constrained by the simple reality that there are only 24 hours in a day and that people will need to spend some of this time doing other things.

Unsurprisingly, the growth trajectory of the industry changes as it approaches these limits. This is illustrated by the 'price-inelastic phase' shown in Exhibit 21. If the pace of consumption growth does not keep up with the pace of productivity growth, then higher levels of productivity simply translate to 'producing more of what is needed using fewer resources.' The result is a flight of capital and the elimination of employment, as what had been 'good jobs' become dead ends.

Over time each new industry – and each new technology – has experienced the same transformation. Think of the agricultural revolution: the promise of new agricultural technology seemed unlimited as consumption went from 1000 mediocre-tasting calories to 2000 tasty ones. However, as daily consumption passed 2000 calories, the marginal value of each additional unit began to diminish rapidly. Demand became highly inelastic, meaning that for every one percentage point drop in price, demand grew by much less than one percent. Exhibit 22 shows the labor-market implications of this shift for the US agricultural industry between the mid-19th and the late-20th centuries: as demand became inelastic, the share of labor in agriculture declined precipitously.

Exhibit 22: Higher productivity in agriculture in the mid-19th century ultimately led to inelastic demand and fewer labor inputs
As demand becomes inelastic, the share of labor dedicated to the industry declines



Source: IPUMS-USA, University of Minnesota, www.ipums.org, Goldman Sachs Global Investment Research.

Each repetition of this cycle has left society better off, since people are able to consume new, less-expensive and better-quality goods, at a higher level of overall income and social welfare. But these transformations are not experienced as positively by the individuals directly affected by the transition from the price-elastic to the price-inelastic phase. The early phases of the cycle, which are characterized by the need to attract employees to new and risky businesses, generate jobs with low barriers to entry, high relative wages and high mobility. Over time, these dynamics foster growth in related 'enabling' industries, including technical training classes, specialized employment agencies, dedicated educational programs and eventually licensing and degree programs – in other words, an organized path to success, which contributes to the view that job creation will remain robust for a long period.

As the industry matures, the pool of jobs tends to shrink to those that require more extensive education and stricter credentials. At the same time, the present value of employment falls, and individuals' significant investments in industry-specific human capital are set against a structurally deteriorating employment picture.

Eventually, and usually without warning, the cycle turns and the job destruction begins. This inflection does not occur because the individual has failed. Rather, it occurs because the industry has become saturated and the underlying technology has run out of new applications. Ironically, it is the industry's inherently greater level of productivity at this point – which creates more output by using less rather than by employing more – that is at fault. From an economic standpoint, in the resource-attracting early phases, the market is characterized by persistent factor shortages and rents for all parties. In the later phases, the market is characterized by persistent input surpluses and falling factor payments, particularly wage income.

Once again, from the standpoint of the economy at large, this transition – from emerging to mature – produces positive outcomes: welfare improvements expand and are spread more evenly. However, to those caught in the reversal, this natural transition seems more personal and possibly even malicious. This persistent gap – between the benefits that accrue to the broader economy and the pain experienced by the individual – helps to determine who wins and who loses over the course of an industry's arc.

Modeling the shift from price-elastic to price-inelastic

In the section below, we present a model that illustrates the effect of productivity growth on labor in a slightly different way. The conclusion is the same: any industry that is subject to an extended period of rapid productivity growth will – by the very fact of that productivity growth – shrink as a share of the economy, as a source of jobs and as a point of accumulation of capital.

Rather than show how the arc plays out over time in a single sector, this model considers the problem from the perspective of a two-sector economy, in which the sectors are distinguished solely by productivity growth. The sector with high productivity growth is the sector with innovative technology; the sector with low productivity growth can here be thought of as 'the rest of the economy.' Our base case assumes fully mobile labor and capital and Leontief preferences and Cobb-Douglas production, and we show labor, capital and budget share over time.

This model has three parts: first, we consider consumption assuming prices are given and utility is maximized; second, we examine production assuming interest rates (cost of capital) and wages (cost of labor) are given and profits are maximized; and third, we analyze the conditions necessary for the market to clear (for consumption to equal production).

Part I: Consumption

On the consumption side, we assume a representative agent has to consume equal amounts of two goods or services C_1 and C_2.[12] In each period t, he maximizes his utility

$$U_t = \min(C_{1t}, C_{2t})$$

subject to his budget constraint

$$P_{1t}C_{1t} + P_{2t}C_{2t} = Y_t$$

where P_1 and P_2 are the prices of the two goods and Y is his income. The solution to this problem is:

$$C_{1t} = C_{2t} = \frac{Y_t}{P_{1t} + P_{2t}}$$

Part II: Production

On the production side, we assume competitive firms produce the two goods or services. To understand how each firm maximizes its profits, we reference the standard Cobb-Douglas production function, which uses capital (K) and labor (L) as inputs.

$$F_{1t} = A_{1t}K_{1t}^{\frac{1}{2}}L_{1t}^{\frac{1}{2}}$$

$$F_{2t} = A_{2t}K_{2t}^{\frac{1}{2}}L_{2t}^{\frac{1}{2}}$$

A_t measures productivity at time t. For simplicity, we assume productivity at each firm grows at a constant rate over time: $A_{1t} = A(1 + g_1)^t$ and $A_{2t} = A(1 + g_2)^t$.

Normalizing the unit cost of capital as 1 and denoting the unit cost of labor as w, we can write the following profit functions:

$$\Pi_{1t} = P_{1t}\left(A_{1t}K_{1t}^{\frac{1}{2}}L_{1t}^{\frac{1}{2}}\right) - K_{1t} - wL_{1t}$$

$$\Pi_{2t} = P_{2t}\left(A_{2t}K_{2t}^{\frac{1}{2}}L_{2t}^{\frac{1}{2}}\right) - K_{2t} - wL_{2t}$$

The first-order conditions from profit maximization imply

$$K_{1t} = wL_{1t} \text{ and } K_{2t} = wL_{2t}$$

For simplicity, we assume the market is competitive and there are no barriers to entry. As a result, each firm earns zero profit in equilibrium and we have:

$$P_{1t} = \frac{2\sqrt{w}}{A_{1t}} \text{ and } P_{2t} = \frac{2\sqrt{w}}{A_{2t}}$$

This result suggests that as productivity increases (i.e., higher A_{1t} and A_{2t}) the price of each good or service falls. In addition, if technological innovations cause productivity to grow faster for good or service 1 than for good or service 2, then the price of good or service 1 should fall faster than the price of good or service 2.

[12] Essentially, we are using a Leontief utility function. We use this specific utility function to simplify our analysis, but the conclusions remain the same as long as the two goods or services are not highly substitutable.

Part III: Market clearing

In equilibrium, consumers consume exactly the same amount that firms produce:

$$F_{1t} = C_{1t} \text{ and } F_{2t} = C_{2t}$$

This market-clearing condition helps us solve for the equilibrium capital and labor inputs

$$K_{1t} = \frac{Y_t}{2(1+\alpha^t)}$$

$$L_{1t} = \frac{Y_t}{2w(1+\alpha^t)}$$

$$K_{2t} = \frac{Y_t}{2(1+\alpha^{-t})}$$

$$L_{2t} = \frac{Y_t}{2w(1+\alpha^{-t})}$$

Where α represents the productivity growth differential:

$$\alpha = \frac{1+g_1}{1+g_2}$$

To illustrate the intuition behind these results, we use an example where productivity in the manufacturing sector grows faster than productivity in the services sector (i.e., $g_1 > g_2$). In this case, α is bigger than 1 and α^tapproaches infinity in the limit. This implies that, over time, both capital and labor devoted to sector 1 (e.g., manufacturing) decrease, whereas both capital and labor devoted to sector 2 (e.g., services) increase.

Lastly, we can solve for C_1 and C_2:

$$C_{1t} = C_{2t} = \frac{Y_t}{2\sqrt{w}\left(\frac{1}{A_{1t}} + \frac{1}{A_{2t}}\right)}$$

Productivity growth (i.e., increases in A_{1t} and A_{2t}) allows consumption to rise given the same income.

Appendix C: How uncertainty keeps individuals from moving out of declining industries

We use an investment analysis to illustrate the dynamics behind individuals' decisions to stay put in declining industries or to move to industries with better long-term prospects.

This analysis shows how uncertainty can cause people to choose to remain in their current industries – even if they believe that the balance of probabilities points to stagnant or falling incomes there and higher incomes elsewhere. Reluctance to transition to a new career will be even stronger among older and higher-skilled individuals. Even relatively mild resistance to such transitions can have significant macro effects: aggregate income will be lower and more-productive sectors will be deprived of labor, while lower-productivity sectors will face large labor overhangs.

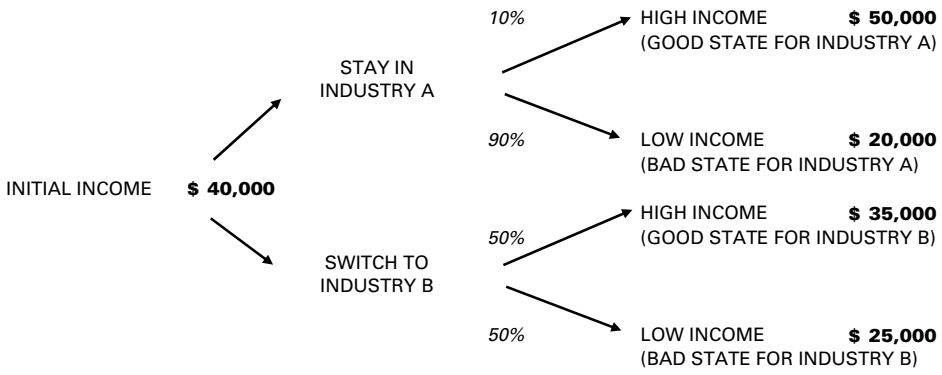
We use a stylized example to show how a single individual might react to the threat of displacement due to technological change. Some people will be in better starting positions, others in worse, and it is difficult to calibrate this analysis exactly. But academic work on displacement and retraining shows that this is an important question worth empirical examination.[13]

Our indicative example considers a person working in industry A, which is facing considerable uncertainty over its future profitability, such as the US manufacturing sector today. Despite the cloudy outlook, there is a small possibility that prices and incomes in that sector could rise again to the levels seen over previous decades (what we call the 'good state' of industry A). However, there is a much greater probability that employees' incomes will stagnate or fall even further as low prices continue to squeeze margins and companies reduce costs wherever possible to maintain competitiveness (what we call the 'bad state' for industry A).

Given this outlook, the person may choose to shift careers by leaving industry A, retraining and permanently moving to a new industry (B) that is not facing the same long-term challenges and where future income is less uncertain, for instance as with today's service and IT sectors. However, this decision carries its own costs, both direct (potentially expensive retraining) and indirect (opportunity costs). In addition, the seniority and human capital this person has gained through formal training as well as through 'learning-by-doing' may be lost or become irrelevant. Accordingly, we assume a less uncertain but lower income stream from moving to industry B. See Exhibit 23.

[13] See for example Jacobson, LaLonde and Sullivan, *"Is retraining displaced workers a good investment?"* 2005.

Exhibit 23: A person considering changing careers faces uncertainty whatever the decision
Potential outcomes for a person considering a career transition



Source: Goldman Sachs Global Investment Research. Note that 'initial income' of $40,000 is based on the median annual income of workers aged 40-44 per the US Census Bureau's Current Population Survey, 2015 Annual Social and Economic Supplement.

'Wait' doesn't mean 'do nothing' when it comes to deciding whether to change careers

We use first a Net Present Value (NPV) and then a Real Option Valuation (ROV) technique to demonstrate the role that income uncertainty plays in affecting the person's decision to stay or to shift industries.

We begin with the expected Net Present Value analysis, assuming 25 more years of working life (for a 40-year-old who will retire at 65). The expected NPV of remaining in industry A (assuming a 5% real discount rate) is $364,000. However, if the person immediately undertakes retraining and moves to a new industry, then the expected NPV will be $452,000 (assuming that retraining costs $1,000 and that the person can immediately start working in industry B, i.e. that there are no opportunity costs from training). Accordingly, out of these two possible paths, the option to 'switch industries immediately' will be preferred. See Exhibit 24.

Exhibit 24: A simple net present value analysis suggests that the person should opt to change careers immediately . . .
Expected NPV of future income streams

	STAY INDEFFINITELY			Period				
		Probability	NPV	0	1	2	3	25
E(NPV | STAY INDEFFINITELY)	Good in Industry A, Good in Industry B	5%	$744,697	$40,000	$50,000	$50,000	$50,000	$50,000
	Good in Industry A, Bad in Industry B	5%	$744,697	$40,000	$50,000	$50,000	$50,000	$50,000
Probability weighted NPV:	Bad in Industry A, Good in Industry B	45%	$321,879	$40,000	$20,000	$20,000	$20,000	$20,000
$364,161	Bad in Industry A, Bad in Industry B	45%	$321,879	$40,000	$20,000	$20,000	$20,000	$20,000
	SWITCH IMMEDIATELY (in P=0)			**Period**				
		Probability	NPV	0	1	2	3	25
E(NPV | SWITCH IMMEDIATELY)	Good in Industry A, Good in Industry B	5%	$527,288	$34,000	$35,000	$35,000	$35,000	$35,000
	Good in Industry A, Bad in Industry B	5%	$376,349	$24,000	$25,000	$25,000	$25,000	$25,000
Probability weighted NPV:	Bad in Industry A, Good in Industry B	45%	$527,288	$34,000	$35,000	$35,000	$35,000	$35,000
$451,818	Bad in Industry A, Bad in Industry B	45%	$376,349	$24,000	$25,000	$25,000	$25,000	$25,000

Source: Goldman Sachs Global Investment Research. Note that if the person decides in P=0 to change jobs, the analysis assumes retraining costs of $1,000 in the same period. Figures highlighted in grey indicate the period in which the change is made and the retraining costs are incurred.

However, as Exhibit 25 shows, additional paths are available. The person can also choose to wait one period and then decide whether to transition to a new industry depending on the realized outcomes for industry A and B in the second period. If income in industry A falls to the low level ($20,000 in our example) and the person moves to industry B (regardless the state of industry B), then expected NPV rises to $490,000, which is higher than either of the two paths we initially considered.

Accordingly, the rational decision is to 'keep your options open' for now and only make the decision whether to change careers later, once the current uncertainty has been resolved. This result is critical, since it shows why *not* making the move to the industry with better prospects can be the rational thing to do – at least in the short-term.

Exhibit 25: . . . but the simple NPV analysis overlooks the fact that the person can wait and postpone making the decision
Expected NPV of future income streams

	WAIT 1 PERIOD: SWITCH in P=1 IF BAD in A			Period				
		Prob	NPV	0	1	2	3	25
E(NPV | SWITCH IF BAD in A)	Good in Industry A, Good in Industry B	5%	$744,697	$40,000	$50,000	$50,000	$50,000	$50,000
	Good in Industry A, Bad in Industry B	5%	$744,697	$40,000	$50,000	$50,000	$50,000	$50,000
Probability weighted NPV:	Bad in Industry A, Good in Industry B	45%	$532,336	$40,000	$34,000	$35,000	$35,000	$35,000
$490,149	Bad in Industry A, Bad in Industry B	45%	$391,396	$40,000	$24,000	$25,000	$25,000	$25,000
	WAIT 1 PERIOD: SWITCH in P=1 IF BAD in A AND GOOD in B			**Period**				
		Prob	**NPV**	**0**	**1**	**2**	**3**	**25**
E(NPV | SWITCH IF BAD in A AND GOOD in B)	Good in Industry A, Good in Industry B	5%	$744,697	$40,000	$50,000	$50,000	$50,000	$50,000
	Good in Industry A, Bad in Industry B	5%	$744,697	$40,000	$50,000	$50,000	$50,000	$50,000
Probability weighted NPV:	Bad in Industry A, Good in Industry B	45%	$532,336	$40,000	$34,000	$35,000	$35,000	$35,000
$458,866	Bad in Industry A, Bad in Industry B	45%	$321,879	$40,000	$20,000	$20,000	$20,000	$20,000
	WAIT 1 PERIOD: SWITCH in P=1 IF BAD in A AND BAD in B			**Period**				
		Prob	**NPV**	**0**	**1**	**2**	**3**	**25**
E(NPV | SWITCH IF BAD in A AND BAD in B)	Good in Industry A, Good in Industry B	5%	$744,697	$40,000	$50,000	$50,000	$50,000	$50,000
	Good in Industry A, Bad in Industry B	5%	$744,697	$40,000	$50,000	$50,000	$50,000	$50,000
Probability weighted NPV:	Bad in Industry A, Good in Industry B	45%	$321,879	$40,000	$20,000	$20,000	$20,000	$20,000
$395,444	Bad in Industry A, Bad in Industry B	45%	$391,396	$40,000	$24,000	$25,000	$25,000	$25,000

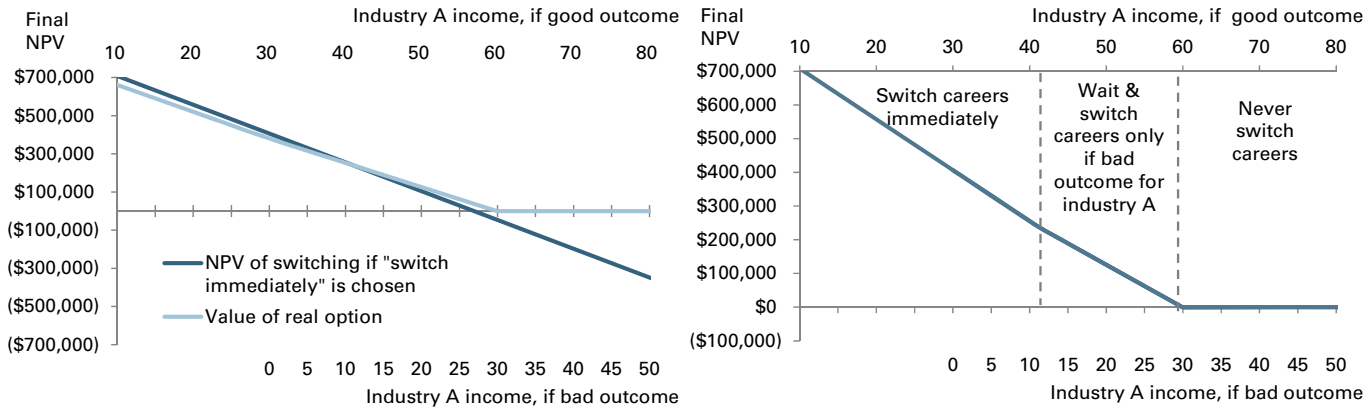
Source: Goldman Sachs Global Investment Research. Note that if the person decides in P=1 to change jobs, the analysis assumes retraining costs of $1,000 in the same period. Figures highlighted in grey indicate the period in which the change is made and the retraining costs are incurred.

The ability to delay making the decision can also be viewed as a 'real option.' In finance, an option gives the opportunity – but not the obligation – to buy or sell a security at a previously agreed price. In our analysis, the ability to wait and make the career-transition decision *later* is also an opportunity, but not an obligation, to move to industry B. We can use the same pricing concepts from finance – namely constructing a risk-free portfolio and relying on arbitrage conditions to equilibrate prices over different states of the world – to price the value of this option to the person.

Real option theory explicitly shows the value of waiting

We start by considering the person's **long position in a put option**, which is the ability to stay in industry A.[14] See Exhibit 26.

Exhibit 26: The person holds a long put position in industry A
Value of the real put option vs. NPV of switching to a new industry immediately



Source: Goldman Sachs Global Investment Research

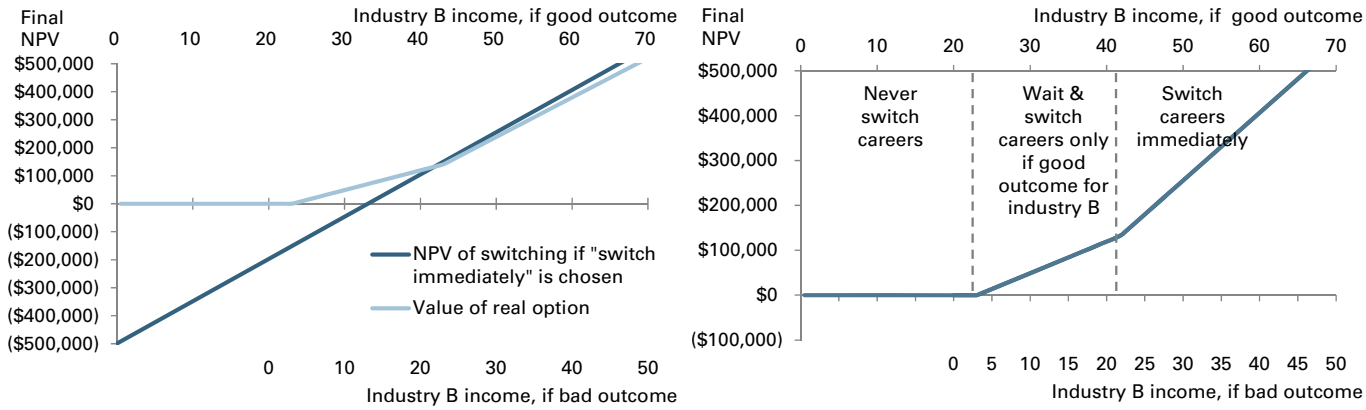
If the worst outcome for industry A is greater than or equal to the best outcome for industry B, then the person will always choose to stay in industry A, even if the state of industry A worsens. The NPV of changing careers immediately is negative and the value of the option to wait for now and move in the future also becomes zero in this region. But if the best outcome for industry A falls low enough (keeping volatility between the outcomes constant for now), then it will always be optimal for the person to move to industry B, as the expected NPV of the 'switch immediately' strategy rises above the value of the real option to wait (even if there are retraining costs).

The complication for the person is that, between these edge cases, the put option does have value, and this value is greater than the expected NPV of immediately transitioning to a new career (see the middle section of the chart on the right side of Exhibit 26). The value of the put option in this region is the value to the person of certainty about industry A's future wages, and the person is prepared to delay making a decision in order to achieve this certainty. Stated another way, the expected NPV of making a decision before knowing the outcome in the next period has to be more than just positive – it has to be larger than the certainty value that would be achieved by waiting (today's option value).

[14] To plot Exhibits 26 and 27, we change the realized levels of income in the good and bad states, but throughout the analysis we maintain a fixed range between these outcomes. This maintains a constant volatility between outcomes. Volatility is itself a key variable in determining the value of the option, which we explore later in this analysis. To simplify the analysis (ensuring a 'closed-form' solution), we also set the industry-B income to its expected value of $30,000 in both the good and bad states, eliminating the uncertainty.

The person also holds a **long position in a call option**, reflecting the ability to change careers and move into industry B.[15] Again we can determine the value of this option using real option theory, as shown in Exhibit 27. The chart on the right side of Exhibit 27 shows three distinct regions. If the best outcome for industry B offers a very low wage (below the worst outcome for industry A), then there is no incentive to change jobs, and the call option is worthless. If the worst outcome in industry B is better than or equal to the best outcome in industry A, then the NPV of changing careers immediately is greater than the option value of the call, and the person will indeed make the transition immediately. Between these regions we again see a range of outcomes where the call option has a positive value that is greater than the NPV of transitioning immediately. In these cases, the optimal decision is to wait.

Exhibit 27: The person also holds a long call position in switching to industry B
Value of the real call option vs. NPV of switching to a new industry immediately



Source: Goldman Sachs Global Investment Research

Combining these results shows that a person has strong incentives to wait over a large range of expected income levels. There is tangible benefit from following this strategy since both the put option (trying to mitigate the downside of remaining in industry A) and the call option (trying to maximize the upside from moving to industry B) have value in this range.

In our two-period model, the person always makes a decision by the second period. However, in a more realistic multi-period scenario, uncertainty may persist for some time, and the 'wait' strategy could remain the optimal strategy for much longer. Accordingly, the rate of transfer between industries A and B would be much lower than either a simple expected NPV analysis or a two-period ROV model would assume. We also assume independence between the outcomes[16] in each industry, which is unlikely to be the case in the real world, since national and global business cycles affect many industries simultaneously. Cross-sector correlation both raises the option value of waiting and complicates the pricing of these options significantly.

[15] To simplify the analysis (ensuring a 'closed-form' solution) for different levels of income in industry B, we set the industry-A income to its expected value of $23,000 in both the good and bad states (i.e. we eliminate the uncertainty from the industry-A income).

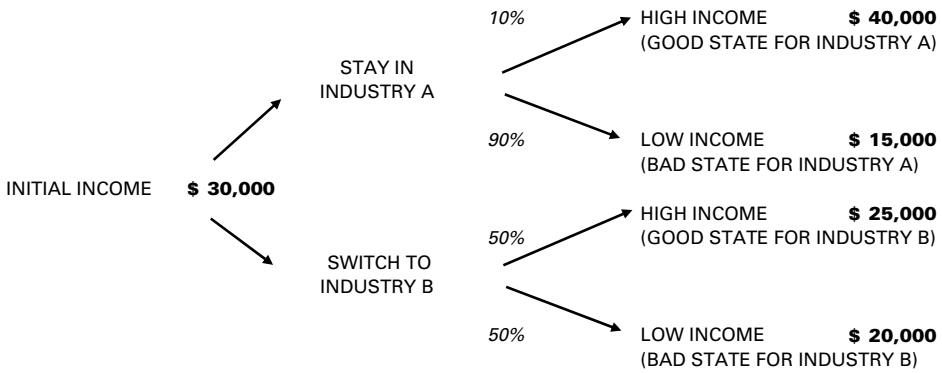
[16] More technically we actually went further by removing uncertainty from industry B in the put-option calculation and uncertainty from industry A in the call-option calculation.

Older and higher-skilled individuals will wait longer, while younger people will move sooner

Throughout this analysis, we have compared the option value of waiting against making the immediate decision to change careers while keeping the range between the binary 'good' and 'bad' outcomes fixed. This is equivalent to keeping the volatility of outcomes fixed.

However, in the real world, an older person or one with highly specialized skills who is considering changing careers will face much greater volatility than a younger person or one who is less skilled or has more generalist or transferable skills. If an older person remains in industry A, he is likely to see a proportionally higher income under the 'good' scenario than a younger one would, because his greater human capital and seniority give him a stronger wage bargaining position. On the other hand, if the older person moves to industry B, the usefulness of his previously accumulated human capital is unclear. This person may see a large decline in the industry-B income if his skills are irrelevant, but he also may see only a small decline if he can successfully transfer his human capital. This adds volatility to the expected industry-B income. In contrast, a younger person deciding to retrain and enter industry B takes significantly less risk because she is transferring – or losing – a much lower level of accumulated human capital (since she has had less time in which to build it). Exhibit 28 shows these dynamics by outlining a set of possible outcomes for a person in her mid-20s who earns the median income for this age group of $30,000.

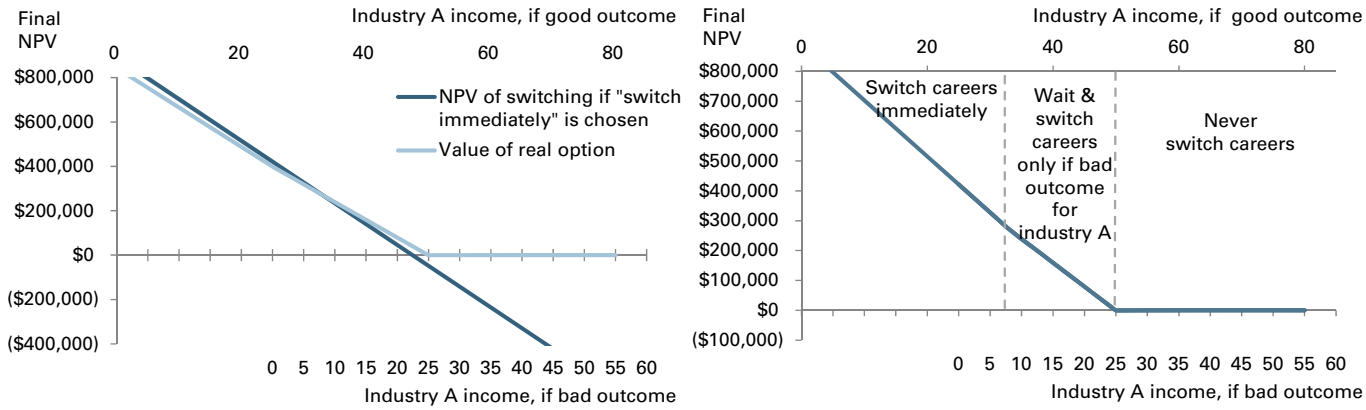
Exhibit 28: A younger person considering changing careers sees less uncertainty, as wages are lower across the board
Potential outcomes for a younger or lower-income person considering changing careers



Source: Goldman Sachs Global Investment Research. Note that 'initial income' of $30,000 is based on the median annual income of workers aged 25-29 per the US Census Bureau's Current Population Survey, 2015 Annual Social and Economic Supplement.

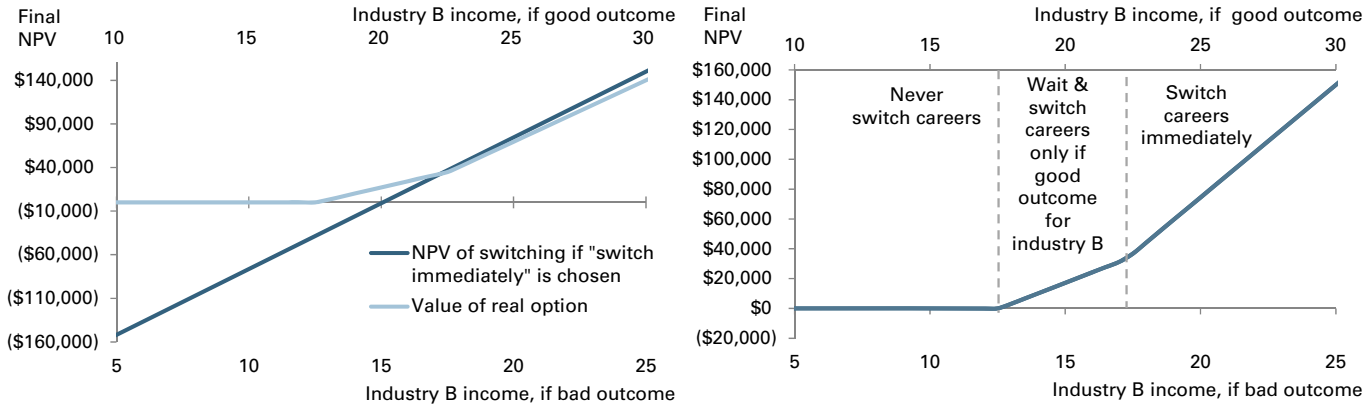
Exhibits 29 and 30 show the investment analysis for this scenario. Repeating the expected NPV analysis, we find that again the 'wait now and move only if industry A enters the bad state' strategy maximizes present value. However, plotting the values of the expected NPV from changing careers immediately against the real option value of waiting, while once again maintaining a constant variance (remembering that the variance is lower this time around), shows that the range of incomes where waiting is the optimal strategy has decreased. This is true for both the put option (for potential industry-A incomes) and the call option[17] (for potential industry-B incomes).[18] Accordingly, a younger person, who faces less uncertainty thanks to her lower starting salary, should spend less time waiting and will be more likely to take the opportunity to change careers immediately.

Exhibit 29: A young person's put option is worth less, making waiting less attractive
Value of a young person's real put option vs. NPV of changing careers immediately



Source: Goldman Sachs Global Investment Research

Exhibit 30: A young person's call option is also worth less, while the NPV from changing careers is worth more
Value of a young person's real call option vs. NPV of changing careers immediately



Source: Goldman Sachs Global Investment Research

[17] To simplify the analysis (ensuring a 'closed-form' solution) for different levels of income in industry B, we set the industry-A income to its expected value of $17,500 in both the good and bad states (i.e. the industry-A income is now certain).

[18] As before, to simplify the analysis (ensuring a 'closed-form' solution) we again set the other industry's income to its expected value.

Limiting the downside will encourage more individuals to make career transitions more quickly

For both older, higher-income and younger, lower-income individuals, we notice the exactly the same pattern in the 'kink' points between waiting and changing careers immediately (Exhibits 26-27 and 29-30).

- **For the put option:** If the best outcome for industry A is worse than the worst outcome in industry B (adjusted for retraining costs), then it will always be optimal to move to industry B, because the expected NPV of the 'move immediately' strategy rises above the value of the real option to wait.
- **For the call option:** If the worst outcome in industry B (adjusted for retraining costs) is better than the best outcome in industry A, then the NPV of moving immediately is greater than the option value of the call, and the person will move.

The reason for this pattern is the 'bad-news principle,' which tells us that the decision to wait is only sensitive to the downward move in income. Stated differently, it is the ability to avoid the consequences of making the wrong decision (the 'bad news') that makes waiting attractive.

Policies that limit the 'bad news' would encourage more people to make successful career transitions in the near term. For the put option this would mean placing a ceiling on wages under the 'good outcome in industry A' scenario, which would be hard to implement in practice. For the call option this would mean placing a floor on wages under the 'bad outcome in industry B' scenario. While subsidizing wages for a prolonged period would be infeasible, this policy support might only be needed in the short term to encourage employers to hire people who are transitioning between fields.

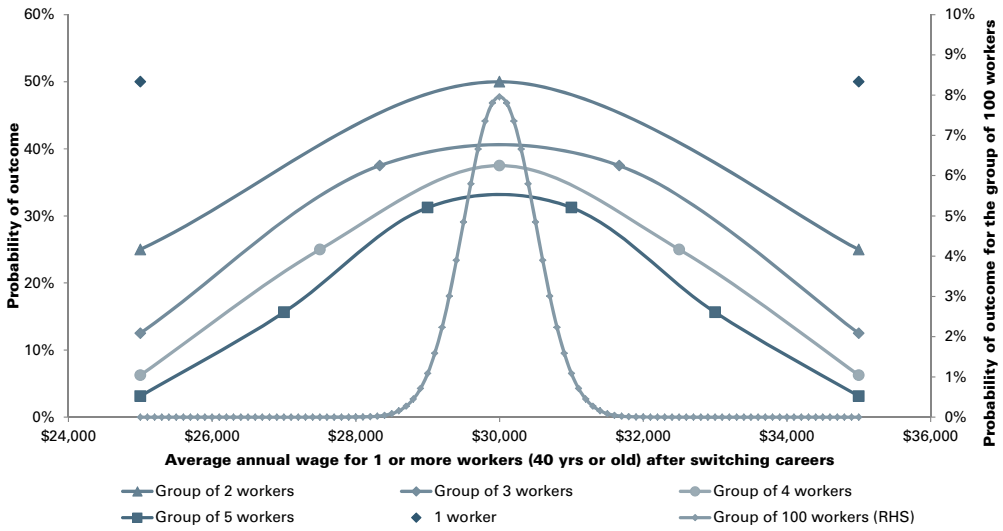
The accumulation of new human capital through 'learning by doing' would lead to higher incomes over the longer term. Policy support could also take many other forms, including subsidized retraining and support in finding new jobs in industry B. Most importantly, since it is uncertainty which leads individuals to delay making career transitions, the existence of any credible policy support – even if most people never use it – should induce most people to make more immediate decisions to change careers.

In the aggregate, the economy benefits from many individual decisions

For the individual, the decision to join a new industry is a 'one-shot deal': his income may go up or down after he has already paid the cost of retraining and allowed his existing human capital to erode. **But for the broader economy, the average effectiveness of retraining is viewed as the average increase in income for the people who do change careers.** This benefit is experienced on a collective basis, not by the individual.

If there are many new industries (and if the good and bad states in each are not perfectly correlated) then by averaging the outcome for many people who shift careers, we get a bell-curve (binomial) distribution, rather than the binary (Bernoulli) distribution that the person sees. As the number of people considering changing careers increases, the variance of the overall distribution of outcome falls towards zero (the bell curve quickly narrows and becomes more like a spike.) As this variance falls, the social option value of waiting (both call and put) also tends to zero. In the extreme case of infinite decisions, there is no uncertainty and the economy will always achieve the expected NPV. See Exhibit 31. Accordingly, if the expected NPV of moving to industry B is greater than the expected NPV of staying in industry A, then it will be optimal to move immediately.

Exhibit 31: The option value of waiting is high on an individual basis, but minimal from a broader economic perspective
The distribution of the average wage narrows as the number of people changing careers rises



Source: Goldman Sachs Global Investment Research

The economy can also internalize positive externalities from the decisions of more people to change careers. There could be benefits for the growth of industry B through normalizing the labor/capital mix (as firms in that industry are no longer deprived of labor), positive returns to scale and network effects from more people in the industry. For industry A, a quicker resolution to the labor overhang should also generate higher income for those people who do remain, because the reduction in labor will increase the marginal product of labor, giving fundamental support for higher wages.

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