

Economic Analysis

# Income disparity, technology and globalization

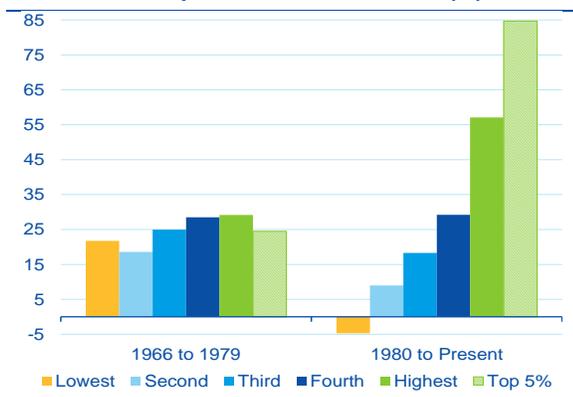
Amanda Augustine / Shushanik Papanyan

- Labor-replacing technologies and globalization are often-cited drivers of inequality
- Factors also include social intelligence premium and pay disparity between workplaces
- Review and reforms of public policies can promote equality in opportunities and access

Income inequality once again took center stage after the Great Recession. The rise of income inequality over the last three decades has often been blamed on the adoption of increasingly more advanced technology. Since the Industrial Revolution, countless researchers have attempted to predict whether humans will soon go the way of horses, and see their jobs replaced by robots due the rise of automation.

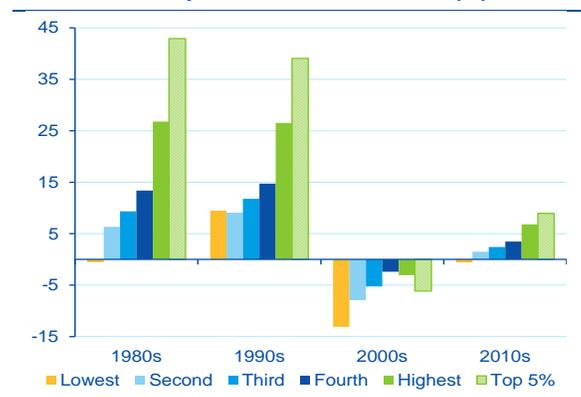
In a competitive market economy, income inequality is unavoidable and even necessary in that it gives the workforce motivation to work hard and gives entrepreneurs an incentive to innovate. However, the widening gap in inequality can have serious macroeconomic consequences, leading to weak and unsustainable economic growth. The implications of the rising income gap for growth and economic stability are all-encompassing — from a decline in GDP growth due to inadequate consumer purchasing power and thus low incentive for businesses to expand or hire,<sup>1</sup> to paralyzed intergenerational upward mobility and inequality in outcomes. This leads to political divisiveness and polarization that, in a vicious cycle, can result in inefficient and unstable economic policies that could further restrain growth.<sup>2</sup>

Chart 1  
Mean Real Income Growth Received by Each Quintile and Top 5 Percent of Families (%)



Source: BBVA Research/U.S. Census Bureau: CPS

Chart 2  
Mean Real Income Growth Received by Each Quintile and Top 5 Percent of Families (%)

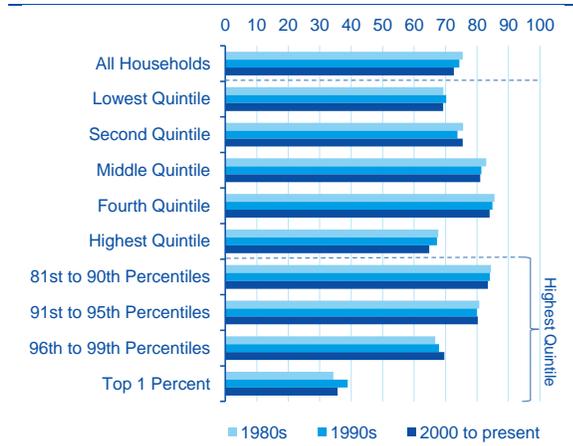


Sources: BBVA Research/U.S. Census Bureau: CPS

<sup>1</sup> IMF study suggests that the increase in the income share of the top 20% can over the medium term decrease GDP growth, while an increase in the income share of the bottom 20% is associated with higher GDP growth due to a number of interrelated economic, social, and political channels (Dabla-Norris, Kochhar, Suphaphiphat, Ricka, and Tsounta, 2015).

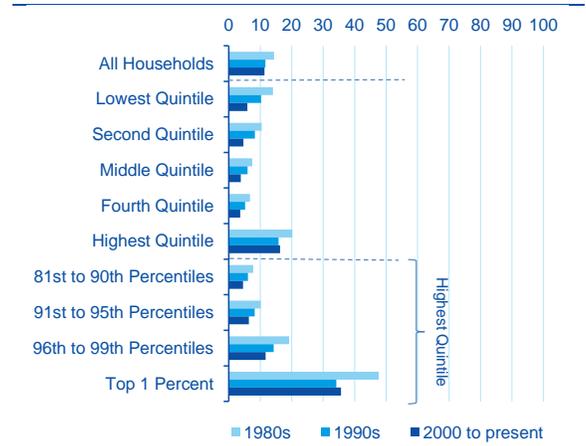
<sup>2</sup> Reich (2014)

Chart 3  
**Labor Income Share of Market Income for All Households (%)**



Source: BBVA Research/CBO

Chart 4  
**Capital Income Including Capital Gains Share of Market Income for All Households (%)**



Sources: BBVA Research/CBO

Income inequality has been on the rise in the U.S. since 1980. While prior to 1980, all quintiles of income distribution grew together, from 1980 and onward, the lower income quintiles grew much slower than the highest one. The Great Recession and the subsequent sluggish recovery further contributed to the widening of the income distribution gap as the bottom quintile experienced a strong negative impact on income growth while the second to fourth quintiles experienced only marginally positive growth.

The source of the widening gap in income inequality has been examined from the labor and capital perspectives. Labor income comes in the form of wages and other types of compensation, while capital income includes corporate profits, rental income, and net interest income. For the households in the lower 99th percentile of the wage distribution, labor income, dominated by wages, is the primary source of income inequality.

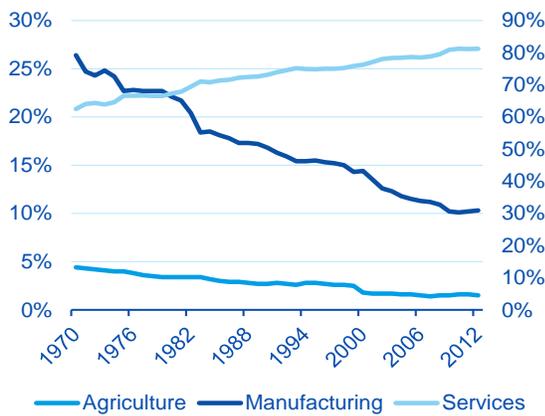
The trend in wage inequality mirrors that of income inequality in that it has been on the rise since 1980. Studies overwhelmingly link its increase in the 1980s and 1990s to the upsurge in labor-replacing technologies and subsequent globalization of labor markets. Since the 2000s though, these factors alone have not been sufficient to explain the wage distribution gap. Additional explanatory factors have been added, such as the extra premium paid on hard-to-measure social intelligence and success, disparity in pay between workplace establishments, and erosion of the minimum wage value in real terms. Going forward, the normalization in wage growth among wage distribution quintiles and the slowdown of wage inequality growth will be dependent upon a change or review of policies to promote equality in opportunities and access. Specifically, these policies include the development of flexible labor retraining programs to accommodate the ever-changing labor market environment, and investment in education, especially early-childhood education with a strong emphasis on development of cognitive skills and social intelligence.

What are the forces behind the rapid rise in wage inequality during the past three decades and the subsequent income inequality, and is the path reversible and/or correctable?

## The role of technological progress

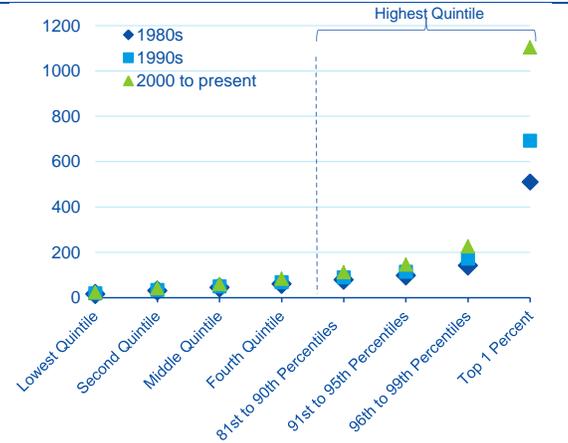
The contentious tradeoff between technology adaption and jobs/wages has been a topic of interest since the dawn of the Industrial Revolution. In 1930, upon the advent of innovations such as electrification and the internal combustion engine, John Maynard Keynes predicted, “We are being afflicted with a new disease of which some readers may not yet have heard the name, but of which they will hear a great deal in the years to come — namely, technological unemployment.” Data exists to back up Keynes’ point. In 1870, almost 50% of employed Americans worked in agriculture — by 2012, only 1.5%; likewise, the share of those employed in manufacturing dropped from over 30% right after World War II to around 10% percent in 2012. The sharp declines in both of these sectors can be traced back to increasing automation, particularly during the 1980s. Despite these trends, many economists debunk Keynes’ theory, arguing that with technology, comes higher productivity and an increase in incomes; however, incomes have not increased across the board. In the U.S., wages for middle-income workers have been stagnant, while those for low-income workers have declined. On the other hand, hourly wages for very high-income workers saw a 41% increase between 1979 and 2013.

Chart 5  
Percent of Employment in Industry (%)



Source: BBVA Research/FRED

Chart 6  
Annual Real Average After-Tax Income for All Households (K, 2013 \$)



Sources: BBVA Research/CBO

**Yesterday:** The growing disparity in wage distribution since the late 1970s has been tied to unbalanced technological progress, which has led to a widened productivity gap between skilled and unskilled occupations. This has resulted in occupational polarization and what economist David Autor has called a “barbell-shaped” job market.<sup>3</sup>

Within the theoretical framework, the outcome of a widened productivity gap has been illustrated as a separating equilibrium with higher quality, high-wage jobs designed for the skilled, and low-capital, low-wage jobs created for the unskilled.<sup>4</sup> Thus, the technological changes of computerization, automation, and digitization have been referred to as “skill-biased.” These changes have been complimentary to high-skilled occupations that require a highly educated and experienced workforce. Studies conclude that information technology can explain as much

<sup>3</sup> Rotman (2014)  
<sup>4</sup> Acemoglu (1998)

as 90% of the increase in relative demand for college-educated workers from 1970 to 1998.<sup>5</sup> At the same time, those same technological changes have driven the decline in medium-wage jobs by replacing workers in routine tasks with low-skilled workers and by enabling the offshoring of routine-task occupations. The declining price of technology has also lowered the wage paid to substitutable, low-skilled workers, while the other low-skilled workers have been reallocated to low-paid but harder to automate service sector occupations.<sup>6</sup>

**Today:** Since the 2000s, occupational polarization has become less important as a factor in explaining wage inequality. While the “hollowing out” of the middle of the wage distribution has continued, growth in the middle- and top-wage distribution occupations has been flat while employment in the lower wage occupations has expanded. The sustained divergence between the 90th and 10th deciles of wage distribution and the flattening of the 50-10 decile ratio have implied the growing importance of hard-to-measure wage inequality factors behind the last decade’s increase in wage divergence. When assessing intra-occupation inequality, two distinct types emerge: residual inequality and establishment inequality.

The acceleration in the speed of embodied technological change and the widespread recognition of information and communication technology (ICT) as General Purpose Technology (GPT)<sup>7</sup> have paved the way for residual inequality. Residual inequality refers to skill-biased wage inequality with a higher premium awarded for unmeasured differences in the skills among workers within occupations and with matching educational attainment and experience. Theoretical models confirm that skill-biased technical change increases the premium paid to skilled workers, even if skills are not measurable.<sup>8</sup> These unmeasured skills are attributed to the “able” worker with high social and cognitive intelligence, the ability to innovate, faster adaptability, comparatively more natural talent, and better ability to cope with the uncertainty of rapidly changing technology. Overall, ICT has made skills in non-routine cognitive activities highly valuable and has elevated the premium to perform problem-solving, creative, coordination and abstract tasks.<sup>9</sup>

The studies have additionally identified a rise in establishment inequality, namely that pay differences between different establishments employing people in the same occupation have also been a major source of inequality.<sup>10</sup>

At the same time, as Acemoglu, MIT professor and avid supporter and developer of skill-biased inequality studies, has highlighted, it is not clear why sustained technological change would be associated with an extended period of falling low-skill wages. He asked, “Why did the real wages of low-skill workers fall over the past several decades?”<sup>11</sup> Studies find evidence that the erosion of the real value of the minimum wage, along with the loss of collective bargaining rights, are significant factors in rising inequality within the lower quintiles of wage inequality.<sup>12</sup> Some studies also link low-skilled immigration and low wage growth for those in the bottom end of the wage distribution, which we address further below along with our analysis on the impact of globalization.

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<sup>5</sup> Autor, Levy, and Murnane (2003)

<sup>6</sup> David and Dorn (2013)

<sup>7</sup> GPT is a term coined to describe a new method of producing and inventing. It should satisfy three attributes: 1) should spread to most sectors, should improve over time and thus keep lowering the costs of its users, should spawn innovation making easier to invent new products and processes (Jovanovi. and Rousseau, 2005).

<sup>8</sup> Juhn, Murphy and Pierce (1993)

<sup>9</sup> Aghion, Howitt, and Violante (2002), Autor, Levy, and Murnane (2001), David and Dorn (2013)

<sup>10</sup> Barth, Bryson, Davis, and Freeman (2014)

<sup>11</sup> Acemoglu (2002)

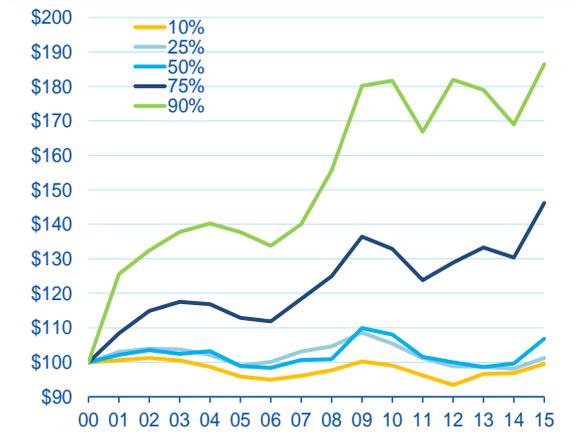
<sup>12</sup> Card and DiNardo (2003), David, Manning, and Smith (2016)

Chart 7  
All Occupations, 2001 to 2015 Annual Wage Growth (%)



Source: BBVA Research/BLS

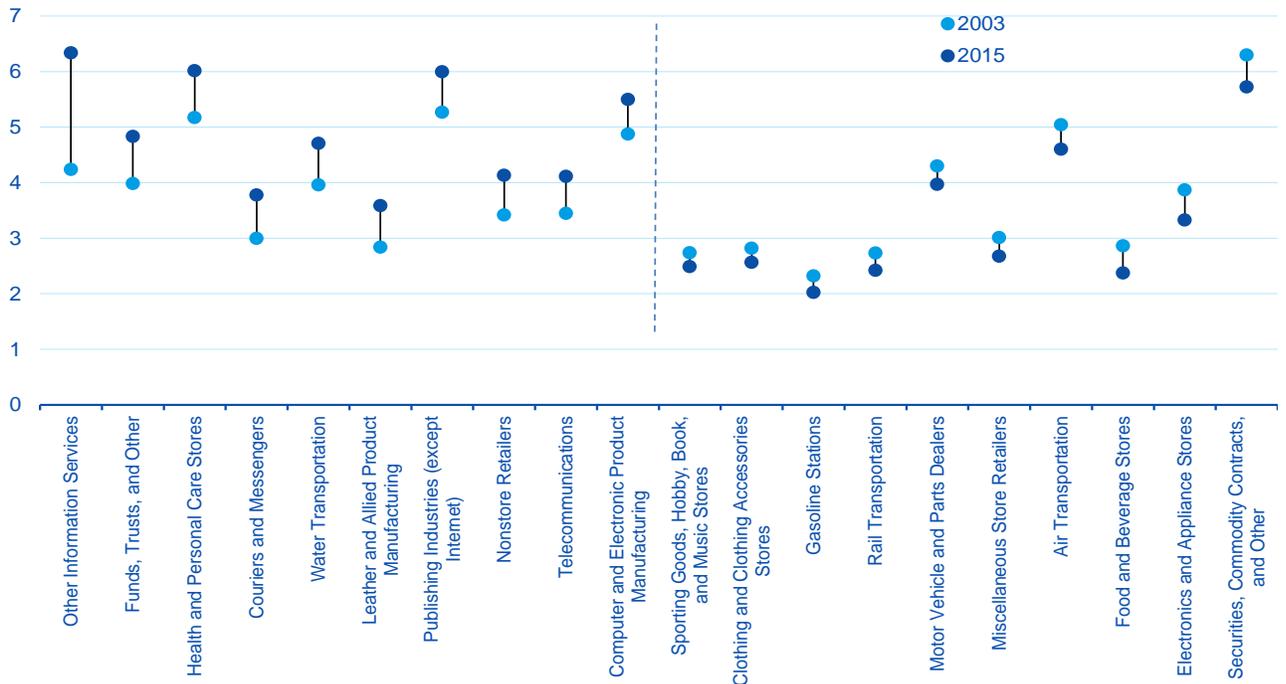
Chart 8  
Growth of Usual Real Weekly Earnings by Decile/Quartile (2000=100, \$)



Sources: BBVA Research/BLS

When looking at the differences between the 90<sup>th</sup> decile and 10<sup>th</sup> decile by occupation, the “other information services” sector clearly displays the greatest increase in wage inequality within the last ten years, along with several other sectors that are exposed to automation and pay a premium for higher education. Meanwhile, the lowest measure of wage inequality was found in service-oriented occupations, especially in customer-facing retail roles.

Chart 9  
Difference in 90-10 Ratios, 2003-15, Top and Bottom 10 Occupations



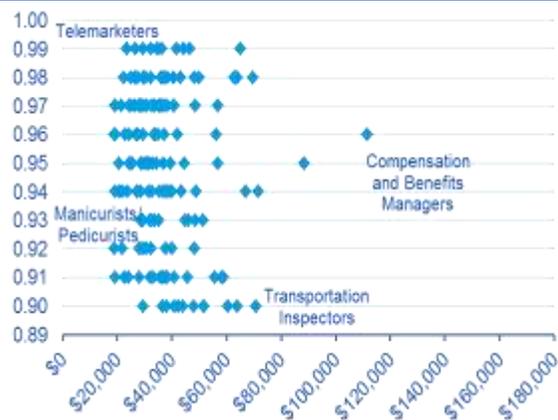
Source: BBVA Research/BLS

**Tomorrow:** Going forward, the increasing premium for human capital and the “hollowing out” of the middle trend will continue. Low to middle-wage occupations will continue to become automated and erode under the extensive reach of GPT innovations. It has been illustrated that increase in GPT has a negative effect on the cost of physical capital. Meanwhile, the cost of GPT itself has plunged, directly decreasing the cost of innovation, computerization, and overall digital capital.<sup>13</sup> Acemoglu referred to the decreasing cost to automate when he stated, “When developing skill-biased techniques is more profitable, new technology will tend to be skill-biased.”<sup>14</sup> Likewise, the GPT makes developing skill-replacing techniques more profitable, and thus more and more new technology will tend to be skill-replacing.

Workers in low-skill occupations will continue to bear the impact of skill-replacing technologies, as incentives grow for managers to substitute people with machinery, and both industries and establishments become increasingly light on labor but heavy on technology. However, theory foresees that low-skilled workers willing and able to switch to service sector occupations that are hard to automate and require interpersonal communication, dexterity, and direct physical proximity should see their wages grow.

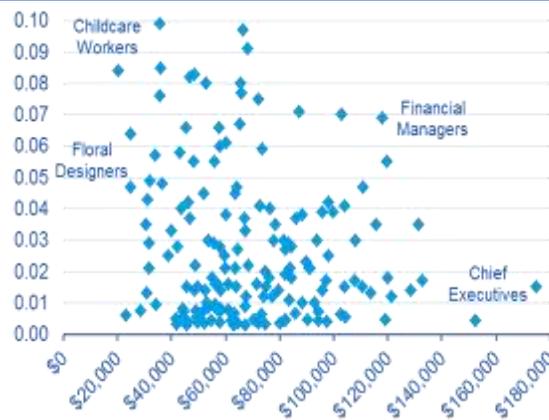
In a landmark study, Frey and Osborne found that 47% of occupational categories were at a high risk of being automated. Among the 702 occupations observed, the ones that had the lowest probability of job losses due to automation included recreational therapists, first-line supervisors of mechanics, and emergency management directors — each with a  $\leq 3\%$  chance of computerization. The occupations which were most at-risk, on the other hand, were telemarketers, title examiners, and hand sewers — each with a 99% probability. Of note, several typically white-collar occupations were also at-risk, including accountants, paralegals, and technical writers.<sup>15</sup> By matching the probability of automation with the median wage of each occupation, it is apparent that the overwhelming majority of these high-risk occupations are in the low to mid-wage range. In line with theory, occupations that are identified as having the lowest probability of automation cover a wide range of the wage distribution.

Chart 10  
**Occupations with Highest Probability of Automation by Annual Median Wage**



Source: BBVA Research/BLS/Frey & Osborne

Chart 11  
**Occupations with Lowest Probability of Automation by Annual Median Wage**



Sources: BBVA Research/BLS/Frey & Osborne

<sup>13</sup> Aghion, Howitt, and Violante (2002)

<sup>14</sup> Acemoglu (2002)

<sup>15</sup> Frey and Osborne (2013)

Social intelligence is indeed the common characteristic among several of the jobs with a low probability of being automated. A recent NBER study found that between 1980 and 2012, the number of jobs which typically have high social skills requirements grew by 10pp.<sup>16</sup> In the same period, jobs which require math skills but little social interaction declined by 3pp. Jobs which required some mix of social and cognitive reasoning had especially high employment and wage growth, and can be expected to continue this growth in the future. For example, the BLS estimated that the occupations which will experience that largest wage and salary employment growth by 2024 are largely in the healthcare and social assistance sector, including home health care services and outpatient care, which typically require both cognitive and social intelligence.<sup>17</sup>

## Is globalization a threat?

Globalization has been enabled by ICT and digitization; thus, it has become harder to untangle its effect on inequality from that of technological advancements. Specifically, offshoring and immigration are globalization trends that are among the often-cited causes of inequality. Traditionally however, offshoring and immigration have very different impacts on inequality. The sector most impacted by offshoring is manufacturing, which typically employs middle-income labor; therefore, offshoring could contribute to the “hollowing out” of middle-income wages that was discussed earlier. Unlike offshoring, immigration increases the domestic labor force and thus has an overall positive impact on economic growth. However it has also been shown to disproportionately increase the amount of low-skilled labor in the U.S., and thus contributes to the decline of wages at the lower end of the income distribution.<sup>18</sup> At the same time, enabled by digitization, the qualitative description and economic impact of offshoring and immigration trends have been changing due to the increasing ability to work globally without the need to relocate. Thus, globalization is expected also to result in subdued wage increases for high-skilled labor.

Global trade openness is also associated with lower inequality. By raising the skill premium, trade could have an adverse effect on the wages of unskilled labor in developed countries; however, by lowering tariffs of exported goods, free trade could also allow companies to reallocate resources and increase wages. All the while, skilled workers gain increased leverage and can benefit greatly from enhanced international opportunities. In developing countries, trade has the potential to lower inequality by increasing the demand and wages of unskilled workers.

Financial globalization represents the global mobility of capital rather than that of labor or goods. While trade openness is associated with lower inequality overall, financial globalization, which includes increasing foreign direct investment (FDI) and portfolio flows, is associated with higher income inequality in both developed and emerging nations. In a recent IMF study, financial openness and deepening, along with technology, were associated with an increase in the top 10% disposable income share across all countries, while trade openness was associated with a decrease. One reason is that FDI tends to be concentrated in technology-intensive sectors, which increases demand and wages for high-skilled workers. However when accompanied by financial inclusion initiatives, financial development could potentially result in lower income inequality, especially in developing economies.

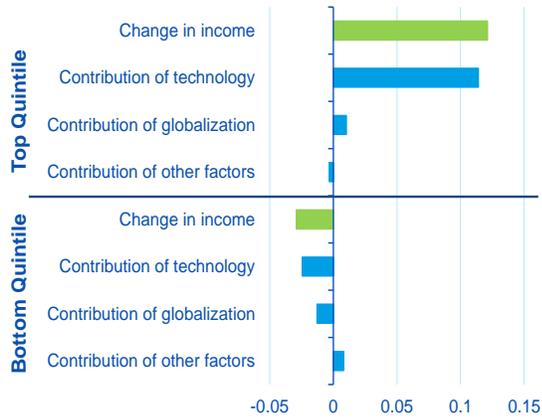
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<sup>16</sup> Deming (2015)

<sup>17</sup> BLS (2015)

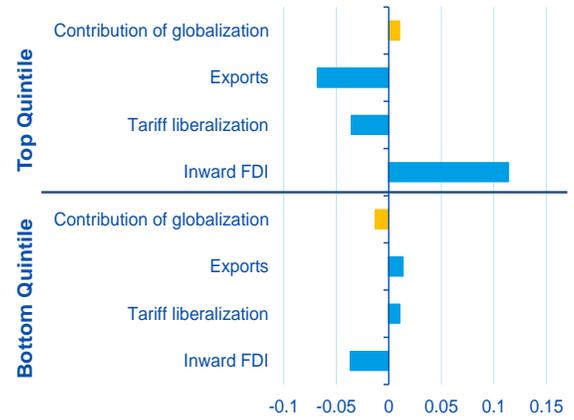
<sup>18</sup> Regev and Wilson (2007)

Chart 12  
**Decomposition of Ave. Annual Change in Income Shares (percentage points)\***



Source: BBVA Research/IMF \*1981-2003

Chart 13  
**Decomposition of Globalization Effects on Income Shares (percentage points)\***



Sources: BBVA Research/IMF \*1981-2003

## Policies of the future: can we fix it?

Blocking the development and distribution of new technologies or taming the forces of globalization and labor mobility (both physical and virtual) by slowing the growth of foreign trade are backward-looking policies that have been shown to limit economic growth, result in loss of competitiveness, and, on net, lower living standards across all wage distributions. In the rise of wage inequality, the digital ecosystem has played a pivotal role through exacerbated payoffs for education and skills. Yet, it is the institutions that have not kept pace with increasing demand for skilled and educated labor. Many economists agree that the rise of inequality is the consequence of a slowing rate of accumulation of human capital.<sup>19</sup>

In order to align institutions and public incentives with the ever-changing digital ecosystem, the U.S. (together with the rest of developed nations) is faced with challenges to reform policies on long-term economic growth sustainability, as well as short-term, cyclical policies to ease the pain of job losses. Using the strength of GPT to empower the workforce coupled with greater investment into human capital can stop the growth in wage inequality and restore middle class.

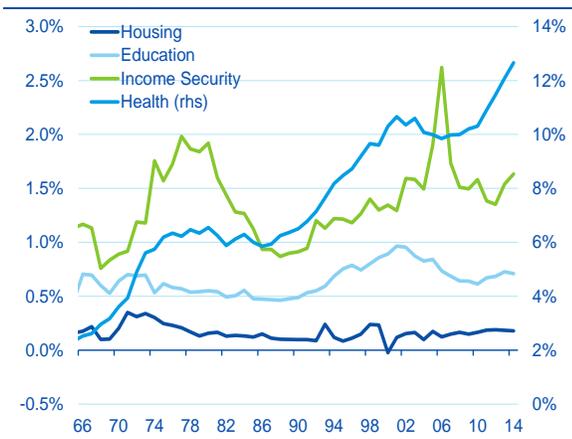
### Policies with long-term growth in mind

**Education:** Reinventing institutions of educational attainment to raise the successful society of the future is a key to economic competitiveness. As technological progress and globalization increase the returns from acquiring higher skills, institutional reforms aimed at early education and pre-school programs are vital in reducing income inequality. The educational institutions of today and tomorrow should aim to equip students of all ages with the ability to cope with uncertainty and to adapt quickly to ever-changing technological demands. Higher value should be assigned to the attainment of social intelligence and interpersonal communication skills. At the same time, public institutions should strive for equality in access to and quality of education. Specifically, the highly rewarded skills of the future, as mentioned above, are harder to acquire and attain for children from lower income families.

<sup>19</sup> Acemoglu and Autor (2012)

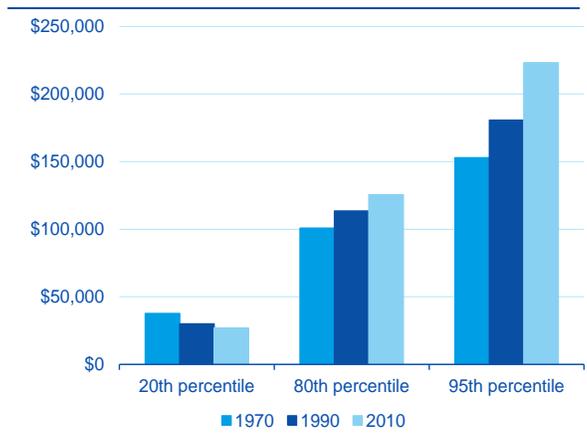
The need to focus on early education is perhaps best explained by economist James Heckman, “We can invest early to close disparities and prevent achievement gaps, or we can pay to remediate disparities when they are harder and more expensive to close. Investing early allows us to shape the future; investing later chains us to fixing the missed opportunities of the past.”<sup>20</sup> Studies confirm that at the age of six, children already display differences in educational development. Often, children from low socioeconomic backgrounds already have a disadvantage when entering primary school and run the risk of falling further and further behind.<sup>21</sup> Thus, the solution to the education inequity can but does not necessitate immediate large policy shift; there is evidence that smaller steps are effective as well. For example, studies have shown that providing educational resources to the families of disadvantaged children can lead to equal opportunity and future economic success. Other policy recommendations include expansion of quality childcare that gets children ready to learn at school and home visits by nurses that help parents better understand their child’s development. Improvements in parental education are especially important as inequality starts at or before birth.

Chart 14  
Share of Real Federal Expenditures by Selected Functions (%)



Source: BBVA Research/BEA

Chart 15  
Children’s Families: Real Incomes (\$)



Sources: BBVA Research/Duncan & Murnane

Martinez-Vasquez et al. looked at trends in a sample of 150 countries between 1970 and 2009 and found that a one percentage point increase in public expenditures on education reduced income inequality by 0.13 percentage points. A similar effect was found when increasing expenditures for social protections, while a one percentage point increase in public health expenditures was associated with a 0.7 decrease in income inequality.

**Technology:** GPT coupled with equal education opportunity can become a powerful force to increase intergenerational mobility. The benefits of the digital ecosystem include low barriers of entry and access to wider networks. For example, the prevalence of the gig economy has created a wave of entrepreneurship, given increased financial access to funding and dormant capital. Current trends in digitization are already supportive of reducing wage inequality. The higher premium placed on interpersonal communication has already led to higher wages in the service sector. In addition, the increasing shift towards virtual labor mobility anticipates slower growth for high-skilled employment.

<sup>20</sup> Heckman (2011)  
<sup>21</sup> Waldfogel (2015)

### Policies aimed at short-term, cyclical stabilization

*Worker retraining:* Given accelerating change in technology and globalization, higher investment in creating more comprehensive retraining programs could be instrumental in minimizing adjustment costs for workers and improving the fairness of labor market outcomes. Because of globalization trends, including immigration and offshoring, domestic workers in import-competing industries experience the impact of the cost of adjustment and transitional unemployment. Federal programs exist to neutralize the effects of job displacement for these workers and facilitate the transition to high-productivity jobs, but they are often criticized for being insufficient in helping workers land economically attractive jobs.

These retraining programs should be reformed to incorporate greater flexibility in order to adapt to changing demands in the labor market. In particular, the key to developing more comprehensive worker retraining programs is improving their ability to provide training for the occupations of future. Rapid technological advancement will continue to raise demand for non-routine tasks that are nearly impossible to envision now.

Increasing public investment in skill acquisition is another option, although this investment would yield greater impact if aimed at programs in trade or vocational schools given the already-wide selection of educational subsidies available for four-year colleges and universities. Initiative should also be taken by private sector companies, which are more aware of the necessary qualifications for their open positions and are thus best suited to provide their own customized training programs. To incentivize the private sector, the government can subsidize wages during the transitional training period or offer tax incentives.

*Labor institutions:* Institutional policies could also assist those at the bottom of the inequality gap, but they fail to solve the issues at the core of the inequality problem, namely technology and globalization.

Some evidence exists that raising the minimum wage can change inequality outcomes for those at the lower end of wage distribution. Wage growth at the bottom decile was strongest in states that legislated minimum wage increases in 2015. The wage growth was 68-88% higher in states with legislated increases and 25-44% higher in states with indexed increases.<sup>22</sup> However, the minimum wage could also result in a ripple effect if employers raise pay for workers earning higher than the minimum wage in order to preserve their relative pay scales, which would do very little to reduce the wage gap.<sup>23</sup>

Other labor-specific policy initiatives that have been proposed also provide short-term relief but would do little to solve the widening income inequality gap in the long-run. Some of these include protecting collective bargaining rights, providing paid family leave, and expanding eligibility for overtime pay.

*Other policies:* Misalignment in demand for skilled labor and supply can also arise from shortcomings in licensing regulations. In some fields, licensing is unquestionably necessary to ensure compliance to safety standards, but in others, requiring certifications and licensures can create rent-seeking opportunities.

Protectionism is also a far-from-ideal way to minimize the negative effects of globalization and technological progress. Manufacturing companies dependent on components and inputs from emerging markets would see in an increase in their costs of goods sold and might cut down on their unskilled workforce as a result. A more

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<sup>22</sup> Gould (2016)

<sup>23</sup> Cooper (2015)

effective policy action is education reform that gives unskilled workers the opportunity to raise their skills premium. In addition, policies that encourage innovation and entrepreneurship, such as simplifying registration procedures for startups, can help developed nations compete in an increasingly globalized world.

## Bottom line

Some degree of income inequality is inevitable and necessary to reward hard work and innovation, but the widening gap in wage inequality poses a threat to long-term economic growth. Technology and digitization, also known as general purpose technology, are at the core of this widening gap in wage inequality and wage polarization. They have spurred the automation of routine tasks, the globalization of labor markets, and the offshoring of U.S. jobs, and thus have lowered wages in occupations that are substitutable — now or in the future — with machines. However, the rapid rise of high-skilled workers' wages is due to the inability of trade schools and educational institutions to keep up with the increasing demand for skilled and educated labor. The educated workforce has been further rewarded, which has widened the inequality gap, by the increasing premium for skills that are hard to measure and hard to automate: cognitive and social intelligence, entrepreneurial and leadership skills, and the ability to adapt and innovate. The declining real value of the minimum wage is also a factor in the restraint in wage growth in the lowest quintile of wage distribution. Low-wage and low-skill workers are the ones bearing the economic cost of automation and digitization and are the most disadvantaged in access to skills complementary to digitization, namely cognitive and social intelligence skills. Thus they are the most disadvantaged in preparedness for jobs of the future.

Both long-term and short-term policy goals should be tailored to complement the rapid speed of technological advancements and digitization. Investment in human capital is the only way to use technological advancement to promote widespread prosperity. With the focus on long-term sustainable economic growth, reforms and reinvention of educational institutions are needed. In particular, early education and pre-school programs reforms are needed to achieve equality in the access to and quality of education. To counteract the cyclical waves of job losses due to automation and offshoring, flexible retraining policies should also be developed where the unemployed are re-trained for high-demand skills and jobs rather than for the vanishing skills of the past.

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