

Not Your Father's Counterfeiting

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Abstract

As the printing industry evolves to a digital platform, the challenge of designing security documents that copy poorly becomes increasingly difficult. As digital printing equipment becomes easier and less expensive to operate and maintain, more widely placed in new environments, with better quality and output design flexibility, the opportunity to counterfeit expands and the profile of the counterfeiter is altered accordingly. This has led bank note authorities to change their strategies for conducting banknote design, public education and enforcement activities, establish cooperative efforts to deter use of digital equipment to counterfeit, and to aid enforcement.

When inexpensive color printing first became reality with the introduction of color copiers less than 20 years ago, bank note security designers explored ways to foil counterfeiters based on the weaknesses in the equipment. Use of these types of features, such as metameric inks, out-of-gamut colors and interference screens, were meant to produce copies obviously different from the originals. Now, such features are insufficient to address today's printing capabilities, and other ways to deter counterfeiting have been sought. Today, bank notes are highly engineered products with many restrictions imposed by production, processing and usage needs.

Bank Notes and Counterfeiting

Since the earliest known use of paper money in China during the 13th Century,^{1,2} counterfeiters have challenged authorities. Bank note designers have been challenged to design notes identifiably different from fakes and enforcement agents have been challenged to apprehend and discourage the counterfeiters. In early China, counterfeiting was discouraged by execution of the guilty, a tradition that continues there now.³

Today, the challenges are essentially the same: bank notes must be easy to recognize as genuine and difficult to copy; counterfeiters must be apprehended and deterred, by judicial disincentive or punishment.

Technology Regimes

However, as technologies available to both bank note producers and counterfeiters have evolved, so have techniques to deter counterfeiting. When widespread use of bank notes began in the 17th century, the genuine notes

were often made from original woodcuts or metal dies. The designs were made to be difficult to copy freehand, the only method available to counterfeiters in the absence of reprographic techniques at that time. Thus the use of images of real leaves from nature, with difficult-to-replicate random vein patterns, and the use of intentional errors, which some counterfeiters would inadvertently correct or omit, were appropriate techniques in designs of the genuine notes for the day.

After the late 19th century, when significant advances in both photographic and printing technologies were achieved, the camera and printing press became the tools of choice for counterfeiters. These technologies were advanced in their time, but with the advent of high technology in the late 20th century, they are now thought of as conventional.

Conventional Regime

Until mid 1980s, when color copiers were under development, counterfeits were usually made on offset presses from plates made from photographic reproductions of the notes. Security features in conventional bank note designs were meant to be difficult to replicate using these techniques. Typical such features include multiple overlaid fine lines printed in highly durable inks of different colors; multiple printing techniques (intaglio, offset, letterpress) and unusual fonts; guilloche patterns with intricate curved lines; detailed intaglio hand-engraved portraits and vignettes; and specially tinted UV-dull cotton paper with watermarks and special fibers or planchettes. These features complicated the counterfeiter's job by making the color separations difficult, increasing the number and difficulty of steps required to make plates, plus the number of plates required. Further, the counterfeiter was challenged to imitate the quality of the line work, the texture of the intaglio images (especially the life-like eyes in the portraits) and to match the paper characteristics. Addressing these challenges required considerable skills, plus a heavy investment in photographic and printing equipment. However, once these issues had been addressed to the counterfeiter's satisfaction, high volumes of the counterfeits could be produced.

In this conventional counterfeiting regime, traditional investigative and enforcement methods played

a key role. Counterfeiting was an intensive business, problematic to conceal, requiring special inks and materials, using large and noisy equipment. Counterfeits made this way carried identifying characteristics picked up from the original note or from process flaws, and counterfeits in circulation could be allied to each other and to a counterfeiter's operation. With good enforcement agencies in place, most of the counterfeits produced could be confiscated before they were distributed and passed on the public.

In this scenario, counterfeiting was kept under control because bank note designs were difficult to mimic with the available technologies, counterfeiting required special skills and equipment, and traditional enforcement techniques were effective at catching the counterfeiters.

High Technology Regime

In the late 1970s, electronic color scanners were introduced, giving counterfeiters a powerful tool that had a direct impact on counterfeiting levels. This presaged the advent of high technology reprographics and put bank note authorities on notice that changes in currency design would be required in response. By mid 1980s, as predicted, color copiers that could be used to print counterfeits with the push of a button were becoming available. The concept of the casual counterfeiter was born.

Color Copiers: By early 1990s, color copiers became readily available in the market and casual (or pushbutton) counterfeiting had become a reality. According to a study conducted by the US National Research Council⁴, in 1992, about 30,000 color copiers were placed in the US (about 60,000 worldwide), and sales were expected to roughly triple over the next few years. That same year, \$6-8M color copier (toner) counterfeits were passed in the US.

In the high technology regime, counterfeiters no longer need special skills, inks, materials or equipment to mimic traditional bank notes. No color separations, film work, plates or presses are required. The tint of the paper is sensed by the scanner and mimicked with the printing medium (toners, or ink). In this regime, counterfeits are easier to make, but enforcement is more difficult. The counterfeits produced, besides requiring no incriminating make-ready or stockpile, are essentially generic, with few characteristics to ally them to each other or to the equipment that printed them. Evidence in court can be unconvincing for conviction, since both the machine and counterfeits are indistinguishable from other machines and counterfeits unrelated to the case at hand. In addition, more people are able to counterfeit, creating a larger number of cases for enforcement agents to pursue, which in turn requires more resources.

To counteract this situation, bank note authorities changed the way bank notes are designed, adding features that aren't readily copied. Such features include optically variable features that change appearance at different viewing angles (holograms, metallic foils and inks, color shifting patches and inks); line patterns that interfere with the scan frequency and induce moiré in the printed output; and out-of-gamut colors and metameric

ink pairs that look different in the original than in the copy. They also established a relationship with copier manufacturers to develop joint technological solutions to the counterfeiting potential. The manufacturing industry had already independently developed anti-counterfeiting systems to deter the use of their products for this criminal activity, which would reflect poorly on the individual companies and inconvenience their customers. The systems developed addressed both identification of the originating equipment and prevention of the illegal reproduction in the first place.

The joint effort was aimed at providing a more universal effectiveness of the anti-counterfeiting systems. The successful result of this joint effort is in effect in products in the market today.

Figure 1 shows that, though some counterfeiters (who may never have had the skills or opportunity to counterfeit before) began using color copiers, many counterfeits were still made in the conventional way in this period.

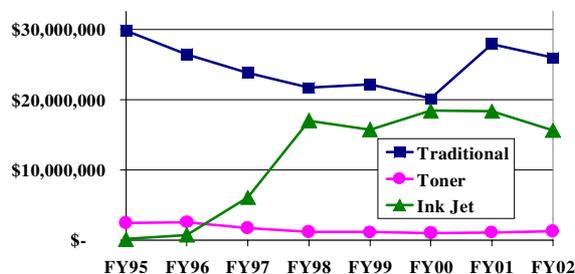


Figure 1. US Domestic Passing Activity

Ink Jet Printers: As color copiers with anti-counterfeiting systems were moving into the market in mid 1990's, another threat was emerging. In 1992,⁴ ink jet printer cost about US \$10,000 but was projected to cost US\$1000 or less by 1995, and today, of course, excellent ink jet printers can be purchased for well under US\$100.

As ink jet printers spread in the market, they began to be used to counterfeit. Within a 9-month period in the US, starting late in 1992, a dramatic increase in both numbers and cases of ink jet counterfeits were seen. The average number of counterfeits from each of the roughly 200 cases was about 10 notes. This trend toward many cases with few notes each has continued. Today in the US, the vast majority of domestic counterfeiting operations (96%) are ink jet, although the foreign-based operations are still largely conventional (mostly offset). In contrast, the proportion of ink jet counterfeits is only 36% of the total passed to the US public. Figure 2 shows the proportion of ink jet vs. other types of counterfeit operations suppressed.

In Canada, which does not experience much non-domestic counterfeiting, nearly all counterfeits, whether professional or hobbyist (with added features and steps) or pushbutton, are made with ink jet printers. However, at present, a large number of professional-type toner counterfeits (with simulated security features) are circulating as well. As toner-based printers and multifunction devices become less expensive and more

prevalent, toner-based counterfeits can also be expected to increase again in tandem. Figure 3 shows the dramatic change to ink jet printing as the method of choice for counterfeiters in Canadian in recent years.

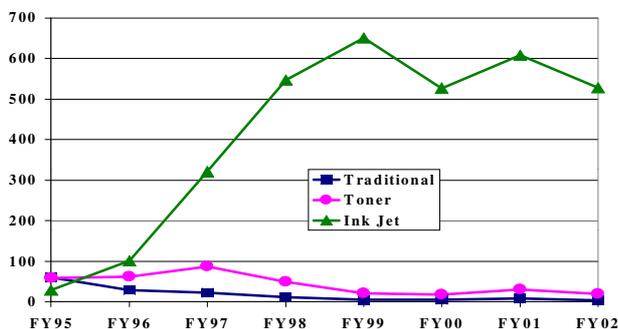


Figure 2. US Counterfeiting Operations Suppressed

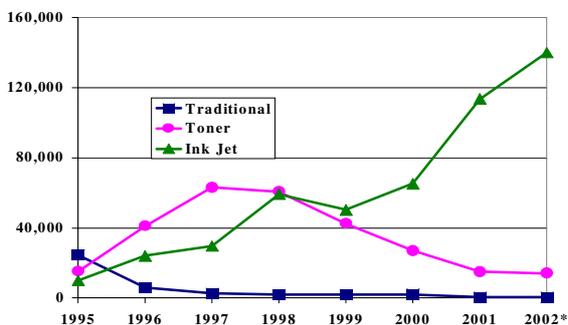


Figure 3. Counterfeits passed in Canada (in number of pieces)
*Complete through September 2002

The counterfeit deterrence techniques used against ink jet counterfeiting are based on the same concepts as those used for toner-based counterfeiting - optically variable features, transmissive features, out-of-gamut colors, screen patterns, etc. However, both scanning and printing technologies have improved to the extent that the features developed to exploit weaknesses in the imaging systems are no longer as useful as they were in earlier days. The color gamuts of imaging equipment have expanded, anti-aliasing techniques overcome moiré patterns, and printing resolutions and color fidelity are high enough that close inspection may be required to distinguish color differences or dot patterns in counterfeits.

Although desktop printers are not generally capable of printing optically variable features, these features can be added in a separate step. The use of these optically variable features in bank notes has given rise to a third type of counterfeiter, the hobbyist or craftsman, the hobbyist counterfeiter may use a pushbutton base image, then add a simulated optically variable feature using materials and techniques commonly available at a hobby or craft shop. A simple metallic foil or ink may be substituted for a color-shifting feature, a generic holographic foil for a security hologram or glitter glue for an iridescent feature. The hobbyist counterfeiter is intermediate between the pushbutton and professional counterfeiter. This type of counterfeiter may produce small volumes of counterfeits like the casual

counterfeiter and may lack the skills, criminal connections and distribution rings that professionals have, but their attempts are willful and premeditated.

To address this counterfeiting threat from ink jet printers, the international central bank community has again undertaken joint efforts with the manufacturing industry to develop and deploy technologies to deter the use of desktop printers to counterfeit. This is an ongoing effort.

High Volume Threat

Most prepress operations have already converted to digital processes and other aspects of production printing are moving toward digital, into broader and lower-end markets than feasible with traditional equipment. This expansion of the market provides further opportunities for unskilled counterfeiters to generate larger quantities of counterfeits with greater ease. Counterfeits generated with digital presses or high-function copiers have all the potential of the conventional methods for producing good counterfeits with all the drawbacks inherent in the lower end digital printers. For the professional counterfeiter, who can distribute their work through criminal channels, the potential is even more troublesome. In addition to the potential for large volume production, digital systems may also have the ability to print in custom colors, change serial numbers on each note, add special inks and produce notes that can't be distinguished from other notes from similar equipment, with little or no evidence from prepress or makeready.

Banknote Design, Technology Solutions

Cases in which digital presses have been used to generate large quantities of counterfeits have already occurred in some countries. When these operations are taken down, the equipment is seized and impounded. If the equipment is leased or still being paid for, the distributor or manufacturer is out the remaining potential funds. Prevention of the use of printing equipment to counterfeit is in the best interest of the public, the owners and manufacturers as well as the bank note authorities. The limits of bank note design are not sufficient to fully address the counterfeiting challenges of today's technological environment, and cooperation between the authorities and industry are again required to find a technological solution to this technological problem.

References

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3. E.g., **China executes 4 in counterfeiting case** 8/11/2000 CourtTVOnline A Hong Kong resident, a Taiwan fishing boat captain & 2 others have been executed in southern China in a crackdown on counterfeit currency...
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